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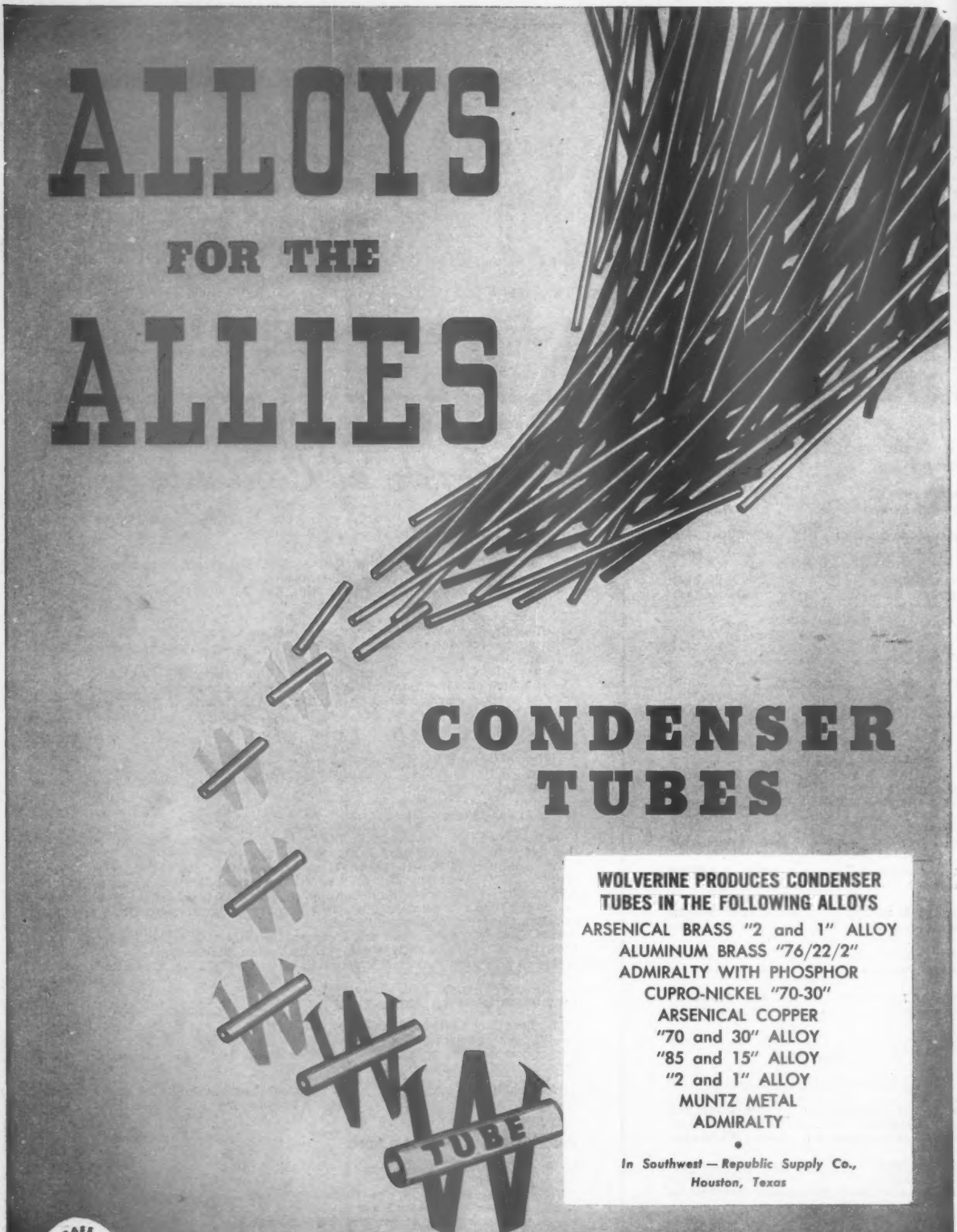

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Trends

Crude-Oil Production
By States—Page 152

CRUDE-OIL STOCKS 238,814,000 bbl. as of Jan. 22—up 666,000. One year ago 233,733,000 bbl.

GASOLINE STOCKS† 79,763,000 bbl. as of Jan. 22—up 1,206,000 bbl. One year ago 86,086,000 bbl.

RESIDUAL FUEL-OIL STOCKS* 53,431,000 bbl. as of Jan. 22—down 896,000. One year ago 71,689,000.

GAS OIL AND DISTILLATE‡ 33,269,000 as of Jan. 22—down 1,656,000. One year ago 40,303,000.

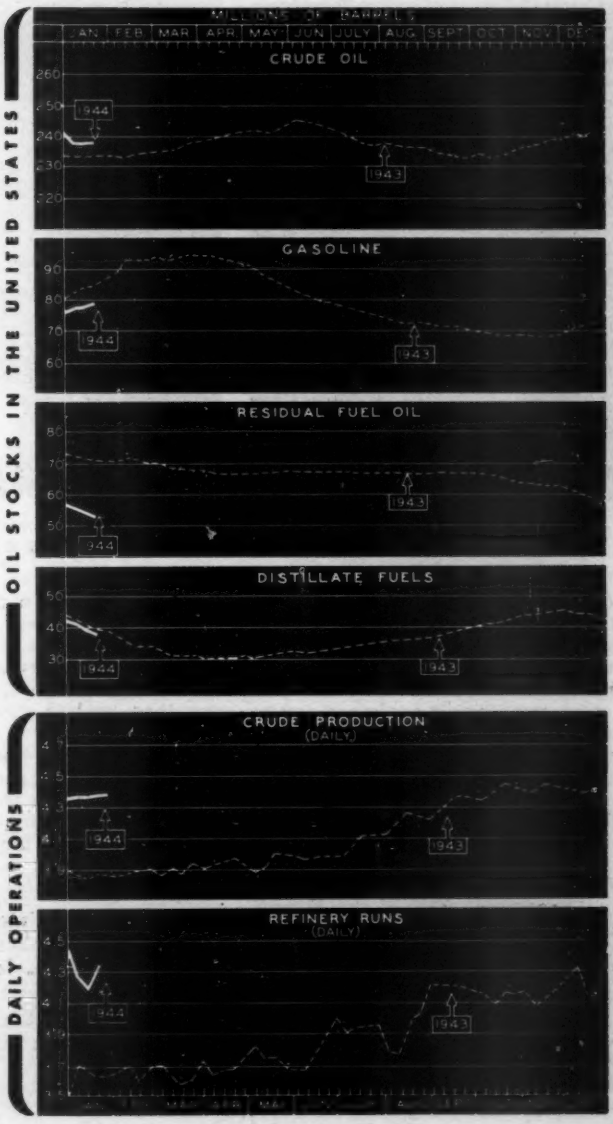
CRUDE-OIL PRODUCTION 4,394,525 bbl. daily average—up 3,170 bbl. One year ago 3,830,885.

REFINERY RUNS 4,368,000 bbl. daily week ended Jan. 22—up 165,000 bbl. One year ago 3,555,000.
Last week revised: †78,557,000; *54,327,000; ‡39,925,000.

FAILURE of domestic crude-oil production to keep pace with projected requirements is a matter of concern to many refiners and also to government officials who are endeavoring to balance 1944 supplies against expected demands. The record for January did not get the year off to a satisfactory start and the expected operations for the new month which started Tuesday are not encouraging. As shown by the charts on this page domestic crude-oil production leveled off starting in late October of last year. It is also true that over most of the past 3 months production of petroleum liquids has been less than the PAW quotas. For the 4 weeks ending January 29 estimated crude-oil production plus natural gasoline and allied products averaged 4,659,234 bbl. daily or 47,916 bbl. less than the PAW quota of 4,707,150 bbl. daily. For the 4 weeks ending January 1 the crude-oil output plus other petroleum liquids was about 50,000 bbl. daily under the quotas. These are estimates and may be altered slightly when final data on operations are made available.

THIS month there is frank acknowledgment that less crude oil is available and the February quota is 5,750 bbl. under the January allocations. The reductions in the case of Districts 1 and 2 are explained as due to decreasing productivity with transportation a factor in the Rocky Mountain area. There is weekly evidence of what this leveling off or declining trend in production means in the operation of several refineries and pipe lines.

AS explained in a Washington report in this issue lack of adequate tank-car-transportation facilities partially explains the shortages of the past 60 days and those in prospect through February. It is understood that refiners in District 2 can expect little help in increased supplies from District 3 until this transportation situation improves. Several refiners in District 2 during December had projected their refinery operations for the first quarter of this year on the assumption that supplementary supplies would be available through tank-car shipments from West Texas. A special effort is being made now to secure part of the tank cars required for this movement. It is stated by those closest to conditions that the solution for the transportation shortage will require the capacity operation of the 20-in. line, the completion of new lines running north and east out of West Texas and increased tanker shipments from the Gulf Coast.



PRC Is Expected to Act Soon On Persian Gulf Petroleum Program

by Henry D. Ralph

WASHINGTON, D. C.—An important action toward development of petroleum resources in the Middle East is expected to be taken in the very near future by the Petroleum Reserves Corp.

A new plant is being considered for strengthening the position of American oil companies holding concessions in the Persian Gulf area and for increasing United States participation in development of production and refining facilities there. Nature of the proposal has not yet been revealed, but officials concerned appear more optimistic of achieving concrete results than they have for several months.

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Directors of PRC met last week to discuss the latest proposal and to hear a report on Middle East oil conditions from E. L. DeGolyer, technical consultant to PRC, and C. Stribling Snodgrass, chief of the Foreign Refining Division of the Petroleum Administration for War, who have just returned from a field inspection of the region.

All that could be learned of the report of this mission was that the delegation was tremendously impressed with the possibilities for future oil production throughout the Persian Gulf region. Geological reports and logs of wells already drilled had previously indicated that this region is probably the largest undeveloped oil reserve in the world, but a first-hand inspection convinced these experts that the production potentialities are unbelievably large.

The DeGolyer mission flew over the entire area in a plane put at its disposal, and visited all the oil-producing areas in the Middle East. One member of the party said that he saw from the air more anticlines in one day than he had seen in a lifetime in Texas.

PRC officials are convinced that the Middle East—the general area between the Arabian and Caspian seas—will be the major source of petroleum supply for the world during the next couple of decades. They also believe that it is vitally important to this country's economic future, and possibly to world peace, that the United States have a large part in the expected development there.

Rumors were intensified this week that Petroleum Administrator Harold L. Ickes is preparing to make official disclosures on the foreign-oil program which PRC hopes to accomplish.

Most of this area has been within the sphere of British diplomatic influence, with the Soviet Government having a considerable hand in the northern section, but three large U.S. oil companies have concessions on the Persian Gulf. Standard Oil Co. of California and The Texas Co. have an extensive operation on Bahrein Island and an exploration concession covering virtually all of Saudi Arabia on which some development work has been done but which now is handicapped by war conditions. Gulf Oil Corp. has a concession in the Sheikdom of Kuwait jointly with the Anglo-Iranian Oil Co. under conditions which make it difficult for Gulf to engage in any development work.

Stronger Position Sought

The objective of PRC is to strengthen the economic, and particularly the political and diplomatic, position of these and perhaps other American companies operating in the Middle East. A suggested method of accomplishing this is to have PRC, a corporation owned entirely by the United States Government, engage in a financial partnership, probably through stock ownership, with private companies which already have a foothold in these potentially rich oil regions.

This suggestion has been denounced by virtually all branches of the American oil industry on the ground that it might open the way for government competition in the domestic field as well as government domination of foreign operations and imports and exports of petroleum. It is understood, however, that this belief is not shared by all the large companies operating abroad, and that a number of important oil company executives believe that if there were adequate assurance that the scheme would not be extended to domestic operations there would be distinct advantages to a government "partnership" in certain types of foreign operations. It is noteworthy that the British and Dutch oil companies which have had much

success in obtaining and retaining foreign oil rights and concessions are owned in large part by their respective governments, whereas the diplomatic policy of the United States in the past has not been uniformly firm in supporting the position of American oil companies in other countries.

PRC is not at present particularly interested in any part of the world except the Middle East, but it is extremely anxious to enlarge and strengthen American oil rights in that area. Reports were published in New York last week to the effect that PRC has a definite plan for construction of pipe lines and refineries in the Middle East and in the Red Sea and Eastern Mediterranean areas, but it is understood in Washington that these reports were based on an old proposal of the PAW Foreign Division designed to obtain more oil for European military operations. The prevailing view now is that extensive new drilling, refinery, and pipe-line projects could not be completed in time to contribute greatly to military activities in Europe unless the war should continue for another couple of years, and that the latest PRC plan is more concerned with postwar operations.

Probe May Hasten Disclosures

One reason for expecting an announcement of definite activity by PRC shortly is the fact that the corporation probably will be investigated by Congress this spring. The Brewster-Moore resolution to liquidate PRC is now pending before the Senate committee on interstate commerce, and a subcommittee has been appointed to hold hearings on the measure in the near future. This subcommittee is composed of Senators Edwin C. Johnson of Colorado, chairman; Burton K. Wheeler of Montana, Clyde M. Reed of Kansas, C. Wayland Brooks of Illinois, and E. H. Moore of Oklahoma. Since the first two are anti-New Deal Democrats, the last three are Republicans, the first four are isolationists, and Senator Moore is a co-author of the resolution, it can be predicted that the hearings may not be sympathetic to PRC.

Although PRC has appeared to be practically moribund in recent months the introduction of the Brewster-Moore resolution seems to have stimulated it into some activity, and the prospects are that the corporation will attempt to make a showing of progress and accomplishment before the Senate committee begins its new investigation. Officials take the position that to fold up PRC in the face of a congressional inquiry would be interpreted as an admission that its position was not defensible.

At least part of the Senate committee's hearings probably will be in executive session because of the claim that PRC's plans are tied up with secret military and diplomatic strategy, but out of the hearings should come some indication of the government's foreign-oil policy in general. For some months high administration officials have been giving thought to the postwar natural resources policy of the United States and within the past month both the State Department and the Foreign Economic Administration have been reorganized and streamlined. Among these shifts was the transfer of Charles B. Rayner from FEA to the post of petroleum adviser to the Secretary of state. Rayner formerly was connected with petroleum operations in the Far East and more recently has been engaged in production in Texas.

Any action which PRC may take must have the advance approval of the State Department, not only because the department has the fundamental responsibility for all foreign policy but also because the Secretary of State is a member of the PRC board of directors and PRC's charter specifically requires State Department concurrence.

A possible hint of the development of a more definite oil policy by the department was given in a recent radio broadcast in which Harry C. Hawkins, director of the department's new Office of Economic Affairs, said:

"We cannot continue to use our American oil even at the rate we have used it in the past without exhausting our supplies. We know that we will have to look abroad for oil. Of course, the primary immediate need for oil is in waging war. But in the years to follow we will need oil for expanded commercial aviation, greater industrial output, more automobiles, more fuel oil furnaces, more oil-burning ships, and so on. The Atlantic Charter provides that all countries shall have access on equal terms to the world's raw materials. That doesn't apply just to foreign countries. It applies to us as well. Americans are already developing great oil fields abroad. The State Department welcomes and wants to encourage this development. The department will certainly see to it that the interests of American nationals in foreign oil resources will get an even break."

Dike to Protect Cumberland Oil Field Near Completion

DENISON, Tex. — Excavation of the two big channels for the dike system that is to protect the Cumberland oil field from the Washita River arm of the Denison dam reservoir has been finished, U. S. Army engineers said last week. Only cleanup work remains to be done.

Construction work still is in progress on the three dikes with approximately 250,000 cu. yd. of earth to be moved for the rolled-fill structures.

Three dikes will block off the Washita and will crest at the 646-ft. elevation. The dike across the main stream on the north end has reached the 636-ft. elevation. The two others have been built up to the 628 and 610 contours.

The Washita above the upper dike already is backed up 5 miles and this will increase to 9 miles before water begins spilling into the detour.

Speculation Returns to Original Program

PUBLIC speculation on PRC's Middle East program returned last week to the original aspects, involving pipe lines from the western shores of the Persian Gulf to the southern coast and eastern end of the Mediterranean and combined refinery capacity of 550,000 bbl. daily at Alexandria, Egypt, and Haifa, Palestine.

Oil men recalled, however, that this complex program was originally conceived during the third quarter last year and at that time was linked with military strategy. More recently, it is understood, the Persian Gulf program has been modified to a less ambitious goal.

Previously, PRC negotiated for a 40 per cent stock interest in American companies' concessions in Saudi Arabia, Kuwait and Bahrein Island. California Arabian Standard Oil Co., jointly owned by Standard Oil Co. of California and The Texas Co., has an exploration and exploitation concession on virtually all of Saudi Arabia. Kuwait Oil Co., Ltd., jointly owned by Gulf Oil Corp., and Anglo Iranian Oil Co., Ltd., has the concession in Kuwait and Bahrein Petroleum Co., Ltd., another Standard of California and Texas Co. subsidiary, has the Bahrein Island properties.

Petroleum Development (Qatar) Ltd., composed of the same interests as represented in Iraq Petroleum Co., Ltd., has developed undisclosed potential production in the Qatar Peninsula. American participation in Qatar is represented by 23.75 per cent stock interest held by Near East Development Co. (Standard Oil Co. [New Jersey] and Socony-Vacuum Oil Co., Inc). Anglo-Iranian and the Royal Dutch-Shell group each control 23.75 per cent share interest while a French family has the remaining 5 per cent.

The most recently published report on the PRC program for exploitation of the Persian Gulf oil properties said that tentative plans call for a 1,500-mile pipe line originating at Qatar in Saudi Arabia, and tying into fields at Damman, midway up the Persian coastline of Arabia, and in Kuwait. Capacity of the reported line would be 200,000 to 250,000 bbl. daily. The pipe line would be 12¾-in. from Qatar to Damman, a 16-in. feeder system from Kuwait with the northern portion being 22-in. pipe.

Another phase of the Persian Gulf program calls for parallel or looped lines in Iran to Abadan with a 900-mile, 20-in. line from that point to Haifa. A third phase of the program calls for 630 miles of parallel or looped line from the Kirkuk field in Iraq to Haifa, a route which now is served with an 8 and 12-in. system.

One of the most modern refineries in the Mediterranean area was completed at Haifa just before the European war broke out. Original plans called for expansion of manufacturing facilities at that eastern Mediterranean terminal to handle 350,000 bbl. daily while a new refinery at Alexandria, Egypt, would have capacity of 250,000 bbl.

Industry to Acquire 150 New Power Rigs, Use All Idle Units

WASHINGTON, D. C.—The domestic drilling industry plans to rehabilitate and put to use virtually all stacked and idle rotary rigs, to acquire 150 or more new power rigs during the year, and to operate an average of 10 per cent more rigs than at present, it is indicated by a survey just completed by the Petroleum Administration for War.

Frank A. Watts, director of materials, reported the survey results to the Petroleum Industry War Council production committee and predicted that an average of 1,700 rotary rigs will be in operation during 1944 as compared with the December 1943 average of about 1,560. In recent weeks, the average number of rotary rigs in operation has been about 1,300, plus about 16 per cent rigging up, tearing down or moving. Drillers reported plans to operate 1,740 rigs during the first quarter of 1944, 1,760 during the second quarter, and 1,810 during the second half.

During the first half of 1944, operators are ordering 109 complete rotary rigs requiring 272 internal combustion engines and 140 mud pumps, and three steam rigs. Reports indicated orders for delivery in second half would be only 35 complete rigs requiring 94 engines and 42 mud pumps, but Watts predicted that actual demand would be higher than this because operators are unable to make plans so far ahead.

In addition to complete new rigs, the survey indicated that rehabilition and maintenance of existing rigs would require delivery of 270 internal combustion and 20 steam engines in the first half and 112 internal combustion and 9 steam engines for the second half; 120 mud pumps first half and 60 second half, and considerable quantities of boilers, blocks, collars, tables, swivels, and other drilling equipment. For both new and old rigs 3,900,700 ft. of various sized drill pipe will be required in the first half and 1,726,000 ft. in the second 6 months. This does not include orders for foreign operations or lend-lease.

During the past 3 weeks the backlog of tool joint orders has increased from 183,300 to 195,200, but Watts said this is not serious since production has increased 1,500 per week and manufacturers report this increase will be doubled during the next 6 weeks. Drill pipe produced this quarter will be about 2,000,000 ft., about equal to total production last year, and this will be some 10,000 more sections than the expected production of tool joints, Watts said. These supplies would fill present needs if manufacturers fill urgent orders first and drillers cooperate in exchanging idle materials. He anticipated that during the year some oil-equipment manufactures would complete war contracts and would return to making oil supplies, but noted that many of the components are still urgently needed for war purposes.

Carter Oil Co. Closes Third Large Property Purchase in Rockies

THE Carter Oil Co., operating subsidiary of Standard Oil Co. (New Jersey) last week effected substantial expansion of its position in the Rocky Mountain territory. Purchase of producing and refining properties of P. N. Fortin and L. B. Hancock, operating as Yale Oil Corp., was the third large acquisition in the Rockies by the Carter company. Previously, Carter purchased producing properties of Santa Rita Oil & Gas Co. and the refining and marketing facilities of Northwest Refining Co. In another acquisition, Carter purchased the entire stock of Minnelusa Oil Corp., with substantial producing interests in the Elk Basin and Lance Creek fields.

The Fortin and Hancock properties purchased by Carter, announcement of which was made January 29, consist of approximately 900 bbl. per day production in the Elk Basin field and capacity of 9,500 bbl. daily at the three refineries. Largest of the refineries is an 8,000-bbl. plant with skimming, lubricating-oil and asphalt-manufacturing facilities at Billings, Mont., northern terminal of a new pipe line authorized by the Petroleum Administration for War and the War Production Board. The other two plants are at Lovell, Wyo., with capacity of 1,000 bbl. daily and at Worland, Wyo., a small unit with 500-bbl. capacity.

Complexion of the Rocky Mountain oil territory is undergoing the greatest change it has experienced in the past 3 decades as a result of the buying and selling of producing properties and the realignment of the major controlling interests. Estimates of the monetary values involves in deals closed within the past 6 months and now pending, but which are not yet ready for official announcements, run up to the neighborhood of $50,000,000. The calculation does not include the large sums paid in recent months for federal leases in and around producing and prospective fields nor contractural deals which involved no changes in ownership.

Among other major deals announced in the past few months were the purchase of a half interest in the properties of the Husky Refining Co. by the Barnsdall Oil Corp.; and acquisition of the properties of the Glacier Production Co., except the gas production and transportation system by the Union Oil Co. of California. Several deals comparable with these are in process of negotiation and are expected to be concluded within the next few weeks.

The relative position of some of the major companies has undergone a change as a result of these developments and of expansion of holdings. Ohio Oil Co., a pioneer in the Wyoming fields, has consistently held first place as a producer of crude. Sinclair-Wyoming Oil Co., which has been especially active in building up production in recent years, now ranks second. Stanolind Oil & Gas Co., the successor of the old Midwest companies; Continental Oil Co., and The Texas Co. are among the leading operators. Carter, through its recent deals, is moving into higher position. Properties acquired in last week's purchase will now form a part of Carter's northwest division operations under the direction of Ralph E. Damp at Billings.

Mexican Geologists Report New Oil-Producing Region

MEXICO CITY, Mexico.—Discovery of a new oil-producing region in the eastern states of Vera Cruz and Tamaulipas is announced by geologists of the Mexican Government. They said preliminary drilling indicates the new zone, if developed, would increase Mexico's oil production 15 per cent. It is hoped to obtain machinery to exploit the new region.

THIS WEEK

DRILLING—Industry to acquire 150 or more new power rigs this year, rehabilitate all idle rigs, increase active drilling units 10 per cent above current levels. . . . ¶Upwards of 2 million feet of drill pipe scheduled this quarter, practically equal to all 1943 deliveries. . . . ¶Rate of tool-joint manufacture increasing 1,500 weekly. . . . Several manufacturers normally producing petroleum equipment will finish war contracts this year, return to supply operations. . . . Probable bottleneck later this year will be critical components, rather than demand and manufacturing capacity. . . .

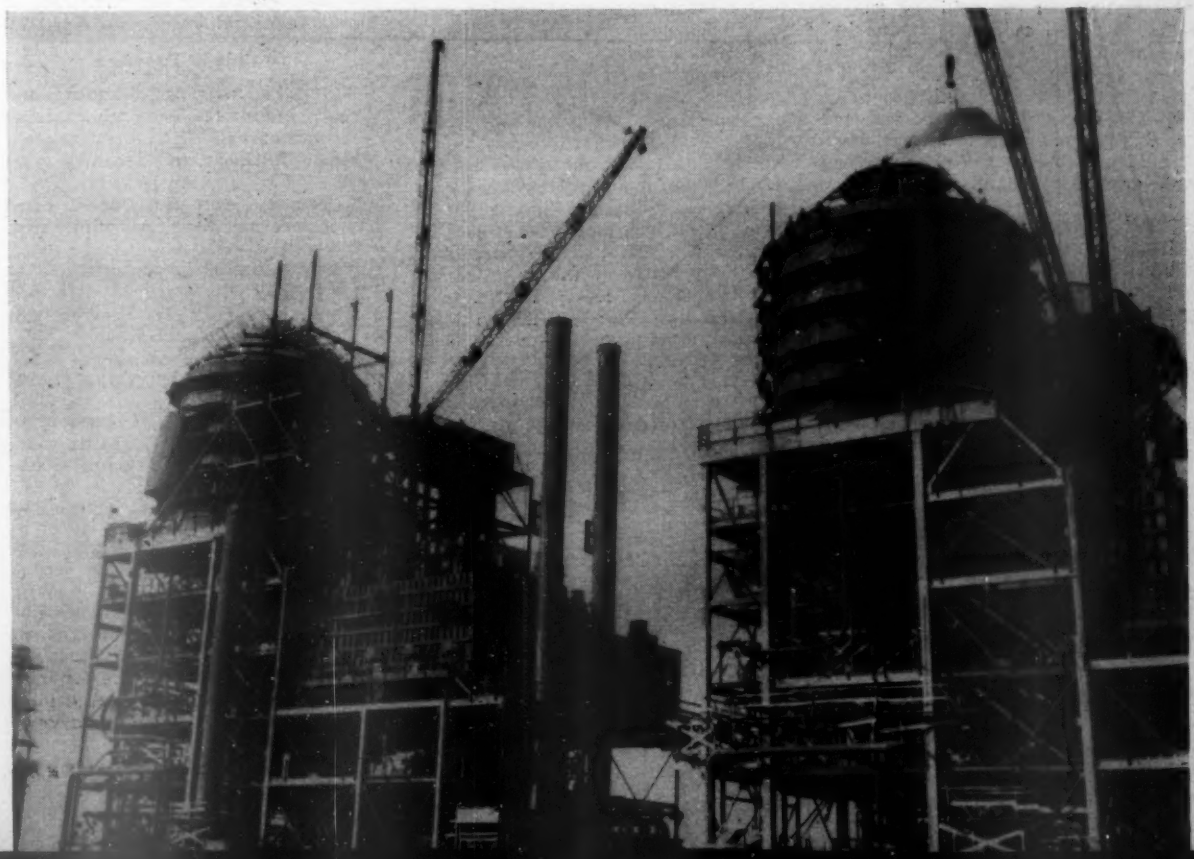
TRANSPORTATION—Distribution of products becoming more difficult. . . . Tank-car shortage growing more acute, because cars are wearing out, many routes are longer. . . . WPB asked to authorize new tank-car construction. . . . ¶First products pumped into Beaumont, Tex., end of 20-in. WEP line, displacing testing water en route to Norris City, Ill. . . . No tank-car transshipments from intermediate terminal in Illinois anticipated. . . . Eastern extension will be available for traffic in a few days. . . . ¶Tank-car reimbursement plan will not be extended to cover District 4, for the present. . . .

REFINING—Three new catalytic-cracking plants go "on the line," leaving 40 more for completion by April 15. . . . ¶District 2 refiners arranging tank-car movement of 40,000 bbl. daily from West Texas. . . . Rail facilities may prevent full realization of program. . . . ¶Eighty-octane, all-purpose motor fuel and 73-octane aviation gasoline elevated to No. 2 priority position. . . . Regulations force maximum production of these two motor fuels, ahead of other less critical petroleum products. . . .

SUPPLIES—Kerosene continues most critical product on East Coast, in Middle West and Southwest. . . . District 2 shippers asked to reduce civilian motor-fuel loadings for eastern seaboard, in order to increase kerosene deliveries. . . . ¶Jet-propulsion planes, a minor consuming factor so far, operate on kerosene . . . ¶Precipitous decline of gasoline stocks on Pacific Coast moderated, possibly temporarily, by seasonal contraction of consumption. . . .

INTERNATIONAL—E. DeGolyer mission to Persian Gulf area reports to Petroleum Reserve Corp. . . . Findings and recommendations remain as mysterious as ever. . . . ¶Original program, now thought to be obsolete, revived in public speculation. . . . Envisages 1,500-mile pipe line from Persian Gulf to Mediterranean ports, Haifa and Alexandria. . . . ¶Senate committee hearings on PRC liquidation resolution may force disclosure of obscured details. . . . Or, Petroleum Administrator Ickes, as some assert, may choose to tell the PRC story in his own way, to the public before hostile Senate committee swings into action. . . . ¶Creole Petroleum Corp. considering 40,000-bbl. refinery at La Guiria, Venezuela, seaport of Caracas, the capital. . . . Another pipe line from eastern Venezuelan fields to Caribbean coastline involved in tentative project.

They're coming in pairs now. One of these two new catalytic cracking plants at the Wood River, Ill., refinery of Shell Oil Co., Inc., was completed January 20 and the other will be on stream in the near future



Higher-Price Advocates Pin Hopes To Bill Giving PAW More Power

WASHINGTON, D. C.—Hopes for breaking the stalemate on attempts to secure a higher ceiling price for crude petroleum are now centering on the Clark-Reed-Wheery bill to give a statutory status to the Petroleum Administration for War and transfer to it all wartime authority over oil and natural gas now exercised by other government agencies.

A subcommittee of the Senate committee on interstate commerce has been appointed and hearings are expected to be scheduled shortly. The subcommittee is composed of Senators E. C. Johnson of Colorado, chairman; E. Worth Clark of Idaho, and Clyde M. Reed of Kansas. The bill was introduced in the Senate last fall by Senators Bennett Champ Clark of Missouri, Reed, and Kenneth S. Wheery of Nebraska, who were members of a special committee which investigated midwestern fuel shortages. The bill would transfer similar authority to the Solid Fuels Administration for War, but provide that both PAW and SFA could delegate functions and operations to other government agencies.

Among other powers, this bill would give PAW the authority to set ceiling prices on petroleum and products, or at least to establish price policies and issue directives to the Office of Price Administration. The bill as it now stands does not specifically require an increase in crude prices but since PAW is on record as advocating an increase of at least 35 cents per barrel the probable effect would be the same. Advocates of a price increase believe that this type of legislation would encounter less opposition from the administration than an outright mandate to increase crude prices as is provided in the Disney bill which passed the House in December. No action has been taken on the Disney bill in the Senate.

All-Purpose and 73-Octane Gasoline on Critical List

WASHINGTON, D. C. — Eighty-octane, all-purpose military gasoline and 73-octane aviation gasoline have been put in Group 2—second preference and critical—priority rating by the Petroleum Administration for War, thus requiring refiners to produce them ahead of lower rated war products listed in the relative priority groupings established last October.

Both products formerly were in Group 3 but military demands for 80-octane have been increasing. Since commitments for 73-octane training gasoline must be protected and stocks used to make this would otherwise go into 80-octane, this product was also raised in priority. Where refinery operations are regulated, PAW will permit refineries to run crude commensurate with maximum production of these products.

Gulf Obtains Exploitation Privileges in Nicaragua

MANAGUA, Nicaragua.—Rights to petroleum exploitation in Nicaragua formerly held by Miguel Descoto have been acquired by Gulf Oil Corp. Gulf is drilling a test well on the East Coast, near Puerto Cabezas.

Taxes on Aviation Gasoline May Finance Airfields

COLUMBUS, Ohio. — Legislation will be introduced at the next session of the legislature looking to improvement of airways and airports with funds obtained from taxes on sales of aviation gasoline. Ohio has two state gasoline taxes. One is a 1-cent liquid-fuel tax. The other, 3 cents on the gallon, is a tax on motor-vehicle fuel for highway maintenance. The latter, when collected on gasoline bought for aviation or any nonmotive use, is refunded if a claim is filed within 90 days. Advocates of the proposed law say the money received from taxes on aviation gasoline would build and support a chain of state-operated airports.

Spacing Pattern Set in Three West Texas Fields

HOUSTON, Tex.—Specific spacing patterns in three West Texas oil fields were established here last week by Adrian Moore, director of production, Petroleum Administration for War, District 3.

The fields and the established spacing pattern are: Fuhrman, Andrews County, 330 ft. from the north and west lines of a quarter-quarter section; Ownby, Yoakum County, 440 ft. from the north and west lines of a quarter-quarter section, and Sand Hills (Ordovician), Crane County, 440 ft. from the south and west lines of a quarter-quarter section.

Alternative drilling locations within 150 ft. of the center of a quarter-quarter section are authorized in all three fields and the spacing provisions of paragraph (f) (1) (iii) of PAO 11 are waived to the extent necessary to permit center locations.

Exploratory Societies Plan Joint Wartime Meeting

DALLAS, Tex.—The joint annual meeting of American Association of Petroleum Geologists, Society of Exploration Geophysicists, and Society of Economic Paleontologists and Mineralogists will be held here at the Baker Hotel, March 21-23.

The program of this second wartime joint conference of the three exploratory societies is being organized with a view of presenting new ideas and methods for improving exploratory efficiency. There will be a reexamination of prospective oil areas in the United States and other parts of the world. The sessions are to be confined strictly to business and technical matters. There will be no banquet, dance, golf tournament, or field trips. Because of limited hotel accommodations wives of members will not accompany them.

The annual business meeting of A.A.P.G. will be held Thursday, March 23. Members will be asked to consider renewal of the certificate of incorporation which expires April 23.

Outline of Program

March 21, morning: Standing and special committees; research committee conferences.

S.E.G. business and technical sessions.

Afternoon: Annual business committee meeting; research conferences.

S.E.G. sessions.

Night: Research symposium.

March 22, morning: Reviews of 1943; presidential addresses.

Afternoon: Special speakers.

Night: Special guest speaker.

March 23, morning: Reexamination of prospective regions; world reserves.

S.E.P.M. business and technical sessions.

Afternoon: Symposium on foreign regions.

S.E.P.M. business and technical sessions.

The usual exhibit of scientific equipment and exploratory methods will be arranged in so far as practical. Also, space will be available for map displays of educational institutions, geological societies, and state surveys.

Withdrawals From Major Fields Forced Higher to Supply Growing War Demand

*by W. V. Howard**

THE oil industry's dependence upon the major fields was well demonstrated last year when of a total increase in production of 107,994,000 bbl., 87,354,000 bbl., or 80.9 per cent, came from the big producing areas. In 1943, these 75 fields produced 55.5 per cent of the nation's output, compared with 53.6 per cent for the 75 largest fields of 1942. In 1941 and 1940, the 75 largest fields produced 53.3 per cent and 58.8 per cent of the nation's crude, respectively.

Reference to Fig. 1 will explain the high percentage from the big fields in 1940, since that year ended a decade of highly successful exploration. Flush production from these fields displaced that from smaller producing areas but as this flush declined the smaller fields came back until in 1943 increasing demands required more intensive efforts and the big fields were called on to meet the demand.

Fig. 1 also shows the lack of major discoveries since 1939. Both of the two recent discoveries which now rank among the nation's largest fields are Hawkins and Reed City and both were found in 1940. Thus, during the past 3 years, there has not been a single discovery in which production has risen to 10,000 bbl. per day and there is little prospect that any discoveries of the past 3 years will ever reach that level.

Several Fields Recede

In 1940, three of the big producers rose in a single year from less than 1,000,000 bbl. to a position among the leading 75. These were Golden Meadow, Eola and Tinsley. Of these, only Tinsley remains in the group. Four fields rose from less than 1,000,000 bbl. to enter the leading group in 1941, Johnsonville, Benton and Hoodville in Illinois and Olla, Louisiana. All have dropped back since that time. In 1942, Haynesville made the only spectacular increase into the major producers and in 1943 not a single one of the 75 leaders rose from even as high as 2,500,000 bbl., Greeley in California coming closest.

Although the average production of the leaders rose from 9,992,000 bbl. in 1942 to 11,070,000 bbl. in 1943, an increase of 10.8 per cent, 19 fields showed a decline in production. Twelve of these were in California, Louisiana, Arkansas and Illinois, each state having three. In California the declines were more than matched by 19 increases, of which 3 were in fields entering or reentering the group. In Louisiana, two fields entered the group while three dropped out and three of the remaining four showed a decline in production. Illinois lost four fields in the leading 75, and the others all showed large declines.

Oklahoma lost one field and the one remaining, Oklahoma City, had a large drop, second only to Tinsley where production fell 9,761,000 bbl.

The greatest number of fields showing increased production were in Texas, with 24 and California with 19. All of Kansas' five large producing fields also showed an increase.

Fig. 2 shows the variation by states of the leading fields. In Texas, California and Kansas the trend has been up since 1940. Louisiana shows a steady decline. In Illinois the peak came in 1941 when there were eight fields among the largest producers. These have declined to three. Oklahoma shows an even greater drop, proportionately, as it had five among the leaders in 1941, compared with only one now.

Coastal Fields Opened

A group of fields which has shown a spectacular increase in 1943 are on the Gulf Coast. These include Hastings, Webster, Thompson, and Anahuac. These fields had been kept more or less under wraps for several years but the heavy demand for crude from the Gulf Coast caused operators to open them up. Another noteworthy

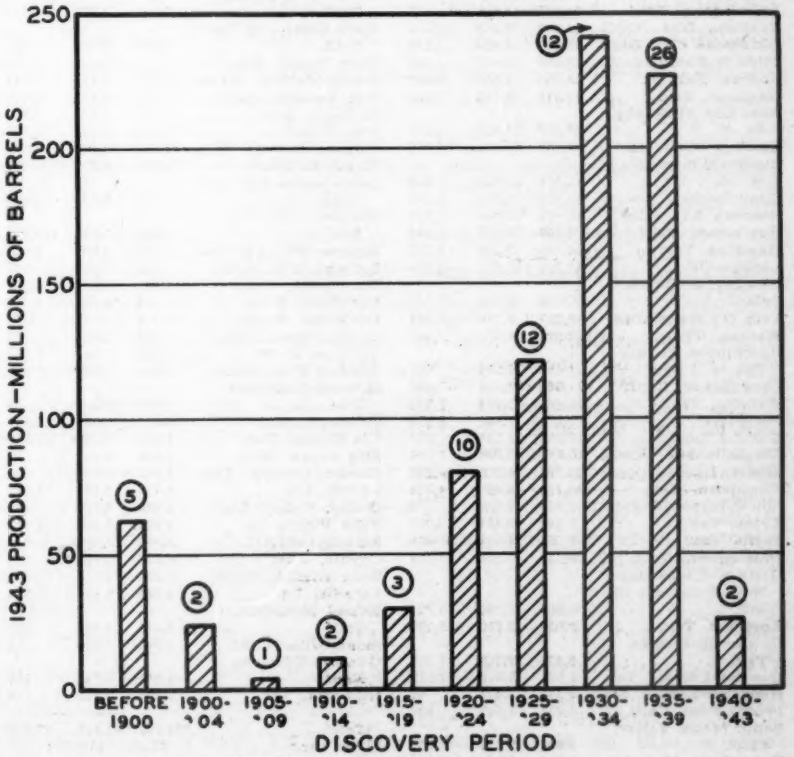


Fig. 1: Age grouping of 75 major fields shows total of 60 in the fruitful 1920's and 1930's, only two of important caliber in past 3 years

*Consulting geologist, Tulsa.

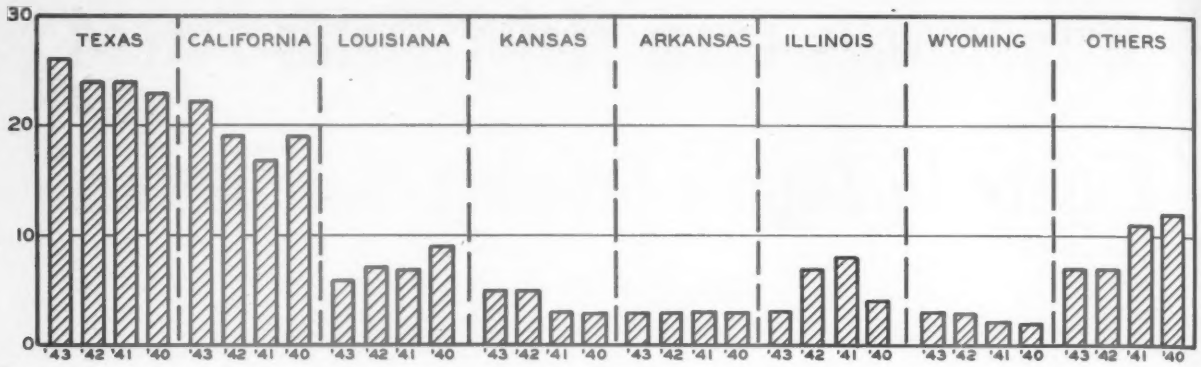


Fig. 2: How the leading 75 fields are distributed by states. Trend shown to heavier withdrawals from states with only remaining surplus producing capacity

record was the increase recorded by nearly all California fields for the same reason. Most of these fields are past their prime but heavy demands for crude forced them to step up production considerably. It is doubtful if the majority of these fields can maintain present levels for long.

Prospects among these major fields for 1944 are that production from the majority of the 19 declining fields will continue to drop. They will probably be joined by a number of California fields, some of the older Texas fields and still others from other states. Best chances for large increases are from some Permian basin fields with other scattered fields gaining some production.

At this time, therefore, it appears that the largest producers will show an over-all decline with probably more than half of the individual fields showing a drop. Few of the present leaders appear to run much risk of being displaced by others. The trend which is now indicated for 1944 is, therefore, a harder pull on those fields which can stand it, with many being unable to maintain current production, and also greater efforts to secure additional production from the large number of smaller fields.

PRODUCTION FROM 75 MAJOR FIELDS

(In thousands of barrels)

	1943	1942	Diff.
East Texas	129,112	120,943	8,169
Wilmington, Calif.	34,381	33,696	685
Coalinga Dist., Calif.	31,388	19,285	12,103
Oklahoma City, Okla.	20,338	26,484	—6,146
Midway-Sunset, Calif.	20,234	20,440	—206
Conroe, Tex.	19,995	13,589	6,406
Hastings, Tex.	17,916	10,555	7,361
Bradford-Allegheny, Pa.-N. Y.	17,257	14,450	2,807
Tinsley, Miss.	17,345	27,106	—9,761
Eunice-Monument, N. M.	16,324	13,820	2,504
Gray County, Tex.	15,770	13,654	2,116
Ventura Ave., Calif.	15,470	13,649	1,821
Kettleman, Calif.	15,299	13,015	2,284
Hawkins, Tex.	14,773	5,256	8,517
Louden, Ill.	13,702	17,961	—4,259
Huntington Beach, Calif.	13,259	12,108	1,151
Tom O'Connor, Tex.	13,027	6,770	6,257
Wasson, Tex.	12,584	9,401	3,183
Hutchinson County, Tex.	11,660	11,399	261
Long Beach, Calif.	11,625	13,124	—1,499
Webster, Tex.	11,473	3,663	7,810
Slaughter, Tex.	11,205	7,531	4,674
K.M.A., Tex.	10,860	11,219	—359
Trapp-Sellens, Kans.	10,840	9,726	1,114
Salem, Ill.	10,220	14,705	—4,485
Thompson, Tex.	10,115	5,405	4,710
Silica-Raymond, Kans.	9,825	9,063	762
Yates, Tex.	9,548	7,481	2,067
Talco, Tex.	9,155	9,599	—444
Dominguez, Calif.	9,112	7,924	1,188
Griffin - Keensburg - New Harmony, Ill.-Ind.	8,865	12,588	—3,723
Anahuac, Tex.	8,839	3,740	5,099
Goldsmith-Harper, Tex.	8,627	7,269	1,358
Cowden-Foster, Tex.	8,539	6,917	1,622
Hendrick-Kermit, Tex.	8,513	8,417	96
Mount Poso, Calif.	8,451	7,517	934
Santa Maria Valley, Calif.	8,305	7,552	753
Reed City, Mich.	7,950	9,042	—1,092
Lance Creek, Wyo.	7,439	8,023	—584
Inglewood, Calif.	6,913	6,749	164
Santa Fe Springs, Calif.	7,309	7,763	—454
Kern River and Front, Calif.	7,275	5,737	1,538
West Ranch, Tex.	6,782	5,303	1,479
Bemis-Walters, Kans.	6,720	4,971	1,749
Ten Section, Calif.	6,558	4,813	1,745
McElroy, Tex.	6,151	4,916	1,235
Van, Tex.	6,120	3,321	2,799
Magnet-Withers, Tex.	6,072	4,239	1,833
Magnolia, Ark.	6,005	6,386	—381
Coles Levee-Tupman, Calif.	5,902	5,437	465
Rodessa, La.-Tex.-Ark.	5,824	7,684	—1,860
Haynesville, La.-Ark.	5,625	4,607	1,018
Schuler & E., Ark.	5,520	5,907	—387
Rio Bravo, Calif.	5,445	3,573	1,872
Elk Hills, Calif.	5,374	4,362	1,012
Cut Bank, Mont.	5,339	5,537	—198
Oregon Basin, Wyo.	5,022	4,427	595
Vacuum, N. M.	4,953	3,443	1,510
Burnett & S., Kans.	4,948	4,097	851
Howard-Glasscock, Tex.	4,842	4,812	30
Greeley, Calif.	4,819	2,580	2,239
Old Ocean, Tex.	4,819	3,550	1,269
Salt Creek, Wyo.	4,806	4,719	87
Carson County, Tex.	4,742	4,398	344
Lafitte, La.	4,714	3,693	1,021
Cotton Valley, La.	4,521	4,985	—468
Ville Platte, La.	4,491	6,820	—2,329
Smackover, Ark.	4,460	4,884	—424
Coyote, West, Calif.	4,426	3,785	641
Brea Olinda, Calif.	4,261	3,714	547
Paradis, La.	4,181	2,196	1,985
Round Mountain, Calif.	4,152	3,927	225
Montebello, Calif.	3,961	3,956	5
Geneseo-Edwards, Kans.	3,941	3,716	225
Hull-Silk, Tex.	3,937	3,819	118
Total	830,270	742,916	87,354
Per cent	55.5	53.5	
Total 75 largest fields of 1942		749,473	
Per cent		53.8	

Crude-Oil-Contract Price Application Limited by OPA

WASHINGTON, D. C.—A strict time limitation in connection with the use of contract sales prices as producers' crude-oil ceilings was announced by the Office of Price Administration January 29.

Ordinarily, ceiling prices of crude oil are at established specific levels or are the posted purchase prices at the pool on October 1, 1941. OPA previously provided that in the absence of a specific price the maximum might be any contract price in effect on October 1, 1941, that was in excess of the posted purchase price.

The stipulation is inserted in the amendment that the contract price prevails only if deliveries were made prior to October 1, 1941, or within 60 days thereafter in accordance with the contract.

OPA has been advised that certain long-term contracts were negotiated prior to October 1, 1941, providing for deliveries to start in 1944. The new provision will prevent contract prices from applying in these cases where the prices exceed the posted purchase prices on October 1, 1941.

Mexico Petroleum Reserves Are Reported to Be Ample

MEXICO CITY, Mexico.—Mexico's petroleum reserves are ample, according to Efrain Buenrostro, director of the government oil industry. Mexico need not worry about her oil resources for at least 20 years, and there is no apparent reason for concern after that, he told a press conference. New fields are being opened, and a geological commission has been named to explore an extensive Pacific Coast region for drilling possibilities.

FOUNDED IN 1910

BY PATRICK C. BOYLE

the OIL AND GAS JOURNAL

Basis for National Policy

THE appointment of a National Oil Policy Committee to make recommendations to the Government relative to domestic and foreign postwar operating policies should serve to crystallize the petroleum industry's views as to what should be incorporated in a long-range program.

Members of the committee will welcome constructive suggestions from the industry generally as they start to work on a plan of primary concern to producers and consumers of future petroleum and the maintenance of a prolonged peace. There should be no hesitancy in presenting viewpoints because it is only by obtaining complete information that a workable plan can be made effective.

As economists in other industries are pointing out, the simpler all planning is made the greater its chance of survival. Many in all lines of industrial activity will want to continue the economic props which are part of the emergency operations. There will be a tendency to postpone or evade the inevitable difficulties of postwar adjustments.

In the oil business there will be the problem of what to do with the 1½-billion dollar investment of private companies and the Government in aviation-gasoline, synthetic-rubber, toluene and other war plants. In the case of rubber every opportunity should be given to determine the permanent position of synthetic rubber in the postwar economy. There is something to be said in favor of continued governmental support until such time as the manufacturing techniques and the service properties of synthetic rubber are determined.

So far as the high-octane gasoline plants are concerned they should be absorbed within the regular operations of refineries or rebuilt for peacetime operations as quickly as possible. Junking has been recommended in other industries for any excess facilities. The suggestion that these aviation-gasoline units or any other war-time manufacturing operations can be shut down and set aside for possible future emergencies is entirely without merit. When the industry's technology is permitted to function again under normal competitive conditions, present processing will be supplanted by more efficient practices. Petroleum refining should be divorced from all governmental competition.

A somewhat parallel condition exists in the case of the emergency pipe lines. Some fear that the two big-inch lines, with their lower costs, will disrupt the industry's transportation system if sold to private owners. These apprehensions are groundless. Big-inch lines were a natural development of prewar pipe-line progress, and the present lines or their equivalent would have been built as conditions justified had there been no war. They and their supplementary lines should be turned over to private owners and their facilities operated under the common-carrier regulations.

A similar procedure is possible in regard to all other emergency activities within and outside this country. Operators know what has happened in agriculture and in other industries when the temporary government supports become permanent regardless of the pretense on which they are based. The bureaucratic tail shortly wags the dog, and freedom of action on which all enterprise in this country has been built, ends. Postwar planners can best serve all concerned by making this fact the controlling one in what they do with a return, as quickly as possible, to prewar standards.

Material-Control Rules Relaxed and Paper Work On Priorities Reduced

by Henry D. Ralph

WASHINGTON, D. C.—The requirement that petroleum operators send delivery orders either to Washington or to district offices for approval before placing material orders with their suppliers was removed last week by an amendment to P-98-b.

In the future, in most instances, operators will be required to file copies of delivery orders with the PAW district offices for information purposes only. Many of the minor amendments clarify previous provisions and simplify procedures for operators.

Simultaneously, with the issuance of Amended P-98-b, PAO 15 was changed to increase from $3,000 to $5,000 the cost of an operation or "project" which may be undertaken without first obtaining specific authorization. The revised order permits use of maintenance and repair materials up to a value of $500 when carrying out projects costing $5,000 or less. The previous prohibition against construction which would result in duplication of facilities is continued in force.

The amended P-98-b order requires the filing of delivery orders both for maintenance and repair and production materials in accordance with the following procedures:

1. **Controlled materials.** — Delivery orders for $100 or less may be placed without filing with any office. One copy only—for information purposes—will be filed when no one item on the delivery order has a value greater than $500 and the delivery order itself totals no more than $2,500. Only those delivery orders which include material with a total cost of more than $2,500 or have any item with a cost of more than $500 will be sent to the district office for countersignature before the order is placed.

2. **Other materials (rated items).**— No copies of delivery orders which call for $100 or less of material are to be filed. One copy only—for information purposes—will be sent to the proper district office for delivery orders for more than $100 of material. Only a few rated materials listed in Schedule B of P-98-b require countersignature before the delivery order may be placed with a supplier.

PAW emphasized that although filing procedures have been simplified operators should conspicuously mark as "M-293 material," copies of all delivery orders which include material such as compressors or heat exchangers scheduled under that order. This marking will assist the PAW district office to segregate, and transmit to Washington, copies of delivery orders which include scheduled items to be expedited on the order boards of manufacturers so that delivery can be made on time.

Tubular Regulations Eased

The new order also grants additional assistance to production operators for the casing, tubing, and drill pipe necessary to their operations. Under the revised P-98-b provision is made for the use of allotment symbol PSO (Petroleum Small Order) to obtain up to 10 tons of carbon steel a calendar quarter for use in production for other than MRO purposes. This 10 tons, it was explained by PAW, will be separate from any allotment obtained by filing a PAW Form 35 application, previously used exclusively to obtain production allotments. The 10 tons should be saved by operators to supplement a PAW Form 35 allotment or to avoid filing forms where limited operations are to be undertaken.

Directions as to filing PAW Form 35 applications for controlled materials have been modified so that only those operators who can plan operations in advance need file applications ahead of the quarter in which material is to be used. Others must still file applications at least a month prior to the time the material is to be delivered. PAW Form 35 may still be used as an interim application on the same basis as before.

Operations in the natural gasoline, refining and transportation branches of the industry have been benefited by the amendment to PAO-15, a previous amendment to PAO-11, and companion revisions in P-98-b, which permit use of materials without authorization in projects having a total cost of $5,000 or less. In this connection P-98-b permits use of Form WPB-541 (PD-1A) to obtain machinery or equipment which will be installed as part of such an operation. All Form WPB-541 applications will be filed with the nearest WPB field office, the PAW said.

Two other minor changes are designed to facilitate the work of operators and eliminate difficulties which have recently caused delay: (1) production operators may now obtain rotary rock bits and core bits without preference rating assistance; and (2) the certification clause has been related to the general certification provision of WPB so as to eliminate unnecessary signing of certifications on delivery orders. Officials emphasized the importance of examining Priorities Regulation 7 of WPB to take full advantage of this provision.

Directors, Officers Chosen By Salt-Water Company

KILGORE, Tex.—Three new directors of East Texas Salt Water Disposal Co. were elected at the annual meeting last week, Bert Fields, independent operator, Dallas; O. G. Leichliter, Mudge Oil Co., Dallas, and C. P. Porter, Blackwell Oil & Gas Co., Kilgore. Reelected were Bryan W. Payne, Iowa-Payne Oil Co., Tyler, president; W. S. Morris, vice president and general manager; J. H. Moyar, Stanolind Oil & Gas Co., Fort Worth, secretary-treasurer; Roy R. Merrill, assistant secretary-treasurer.

Reports on the company's operations showed 128,000,000 bbl. of oil (daily average of 352,351 bbl.) was produced in the East Texas field during 1943, with a pressure drop of only 3.27 lb., according to the records of the Railroad Commission of Texas, indicating that more than twice as much oil was produced in 1943 per pound pressure loss as in any other period in the life of the field.

The company has 30 salt-water disposal systems in operation in the East Texas field and is injecting more than 200,000 bbl. of water daily. Approximately 70 per cent of the water produced in the field is now returned to the reservoir.

The control board which enables a comparatively small crew to operate the almost entirely automatic unit

Humble's Second Catalytic Cracker Is Finished

HOUSTON, Tex.—A second fluid catalytic-cracking unit, embodying the latest advancement in refining technique, went "on the line" at Humble Oil & Refining Co.'s Baytown, Tex., plant January 29 to boost materially that company's contribution to America's growing wartime demand for synthetic rubber and 100-octane gasoline.

Humble's Baytown plant already holds the distinction of having produced more 100-octane gasoline and other critical petroleum war products than any other petroleum refinery.

The new structure, owned by the Humble company, towers some 240 ft. in the air. It takes its place in the Humble refinery as a flexible unit, capable of supplying raw material to any of several important war product finishing plants.

Isobutane, isopentane, and pentylenes from the new unit will go principally toward the manufacture of aviation base stocks and 100-octane gasoline and components in greater quantities; the butylenes may go either into the aviation-gasoline program, into butadiene, or into butyl rubber when the butyl plant adjacent to Baytown refinery goes into operation early this spring. Currently, however, it is anticipated that the butylenes will flow directly to the butadiene plant to bring it up to capacity production of more than 30,000 tons annually for the first time since it was opened in August 1943.

The new skyscraper's sister unit, also owned by Humble, which began operating late in 1942, is currently being charged with approximately 17,000 bbl. of feed stock daily. The new unit is designed to process in excess of 18,000 bbl. a day.

"Cat Cracker No. 2," as it is called, was planned in connection with the butadiene and butyl-rubber plants, but since the butadiene unit was completed in August of last year, well in advance of the new catalytic-cracking unit, it had to depend to a large extent for its butylene supply on the original "cat" unit.

Both the old and the new units employ the fluid-catalyst process which involves the use of large quantities of powdered catalyst for circulation through the feed-stock stream. The original unit at Baytown circulates about 10 tons of catalyst per minute, while the new one is designed to circulate approximately 40 tons per minute.

The two differ materially in some

Humble Oil & Refining Co.'s second fluid catalytic cracking unit, a 240-ft. installation which began operating last week

other respects, the latest addition embodying several mechanical and design improvements resulting from pilot-plant operations in the past 2 years.

The upflow principle is employed in the original unit; in the new one it is the bottom drawoff method. Conventional-type furnaces for heating the charge stock on No. 1 unit have been eliminated on the new one. The necessary heat is supplied primarily from the regenerator in which carbon is burned off the spent catalyst on its way back into the reactor system for reuse. This change in design eliminates furnaces and several other large vessels, reducing the amount of equipment made from critical steel and reducing also the amount of maintenance work necessary.

Because of these design improvements the uppermost vessel in the unit is supported at a lower level than in the older unit, and the overall height is reduced by approximately 25 ft. In spite of this, however, a considerable quantity of steel went into the new unit's construction. Its massive framework, its complicated maze of pipe, and its sturdy steel vessels contain approximately 8,300 tons of steel, exclusive of the amount of steel used in the necessary machinery.

Both the old and new units are almost entirely automatic and require relatively small operating staffs. Their work is confined almost entirely to the control room whose walls are a series of large panels filled with gages, meters, and electrical control instruments. The operating personnel for the new Baytown unit was trained at the older unit while the new one was under construction.

Tank Cars Growing More Vital to Adequate Petroleum Distribution

WASHINGTON, D. C.—The shortage of railroad tank cars, which is acute as at any time since the outbreak of war and is getting worse, appears to be the key to the petroleum supply situation in virtually all parts of the country.

Now that the Defense Supplies Corp. has announced a new plan for compensating excess transportation costs for shipments of West Texas crude to Mid-Continent refineries without relation to the excess-profits tax position of refiners, the way is cleared for shipment of upwards of 40,000 bbl. of crude daily provided tank cars can be obtained, and this new demand will put an even greater strain on the country's fleet of available rail facilities.

The Office of Defense Transportation announced last week a series of actions to speed up rail and truck movements of oil to the East Coast, including a plea to oil shippers to reduce tank-car turnaround time.

The weekly East Coast supply bulletin of the Petroleum Administration for War laid particular stress on the tank-car scarcity as a reason for short oil supplies in the East.

Tank-car shipments of petroleum and products into District 1 during the week ended January 22 totaled 683,204 bbl. daily, representing a continued improvement from the low point of 570,000 bbl. during the week of December 25. PAW officials hope to get tank-car shipments up to 700,000 bbl. daily, or higher if possible, but have no hopes of again reaching the former peaks of around 900,000 bbl. For one reason, there are 9,000 fewer tank cars now available for East Coast oil movement, since 5,000 have been shifted to moving petroleum products from the Gulf Coast area to California and the balance have been diverted to other oil movements or to other industries. Also it is no longer possible to use tank cars on relatively short hauls into District 1, partly because there is little oil available in District 2 but chiefly because there must be a continuous movement of products away from District 3 war products refineries to permit uninterrupted maximum operation of those plants.

Tank-Car Construction Urged

Pressure is being put on ODT to ask the War Production Board to authorize the construction of additional tank cars for petroleum movement. So far both agencies have felt that they are not justified in diverting steel and shop facilities from other war needs in order to provide additional tank cars and impose additional transportation burdens on the railroads.

Reduction in the value of gasoline ration coupons has been considered by PAW and the Office of Price Administration, both for the East Coast and the Pacific Coast, but no change has been announced to date. The West Coast supply situation has been under particularly close study and some action to reduce consumption there may be expected in the near future.

The demand for tank cars for moving petroleum products and many other commodities is increasing in all parts of the country and the situation is approaching a major crisis.

Texas Co. Buys Properties Of Trans-Tex and Affiliate

HOUSTON, Tex.—Producing properties of Trans-Tex Petroleum Co. and its affiliate, Interstate Pipe Line Co., have been purchased by The Texas Co., following a meeting here of executives of the three companies involved at the home of E. C. Dimpliff, president of Trans-Tex and Interstate. The consideration is not given out.

Trans-Tex sold 20 leases on which were 94 wells. Eleven are in the Illinois areas; seven in Smith Mills pool of Kentucky, and two in Indiana. Production is estimated at 1,000 bbl. a day. Dimpliff and associates did not sell their properties scattered over Texas, it was reported.

Completion of Canol Project Advised by Army Men

SAN FRANCISCO, Calif.—Completion of the Canol oil-line project is considered advisable by Army men, according to Capt. Maxwell I. Rae, chief of San Francisco U. S. Engineers office. The line parallels the Alaska Highway. Captain Rae said:

"Arguments that the period of military expedience is past, with lessening of Japanese threat to continental North America, are not accepted by the men who are completing this supply route, with its fueling system, to the north, and who hint that traffic can move in two directions."

Sour-Gas Allowable Fixed At 710,363,000 Cu. Ft.

AUSTIN, Tex.—Allowable production of sour natural gas from wells in the West Panhandle field was set at 710,363,000 cu. ft. for February by Railroad Commission of Texas in an order issued last week. The order says the commission finds that the combined producing capacity of wells in the sour-gas area of the West Panhandle field is in excess of reasonable demand and that preventable drainage of gas between tracts segregated as to surface position and common ownership exists or is imminent. To prevent or minimize such drainage it is necessary to restrict production to reasonable demand and to prorate such demand on the basis set forth in the statutes and in orders issued by the commission.

Navy Opposes PAW Plea for More Elk Hills Production

WASHINGTON, D. C.—The Navy will not favor any increase in production in the Elk Hills Naval Petroleum Reserve unless Congress orders it, Rear Adm. H. A. Stuart, director of the Office of Naval Petroleum Reserves told the House public lands committee here last week. The petroleum administrator for war, Harold L. Ickes, has formally requested the secretary of the Navy to increase production from the current level of 15,000 bbl. a day to 50,000 bbl. a day to relieve the acute supply shortage on the Pacific Coast.

A new contract between the Navy and the Standard Oil Co. of California was submitted to the committee. The contract, Stuart said, is advantageous to the Government.

"In earlier contracts," he continued, "we took Standard's shirt. In this one, we get the coat, vest and pants as well."

Unit Operation Provided

The new contract provides for the protection and operation of the field as a unit under Navy's control. Standard is permitted to withdraw 15,000 bbl. a day from its share, approximately 36 per cent of the oil in the reserve, for the duration of the war plus 6 months, with a maximum of 25,000,000 bbl. in all. By this method, Navy's share of the oil is kept intact, and Standard can get no more than 33 per cent of its own share unless Navy orders additional production.

The contract has been executed by Navy and Standard, and was sent to the attorney general for an opinion. While neither approving or disapproving of the contract, the attorney general suggested that it should have congressional consideration.

Technically, the current hearings are on H.R. 2596, a bill to extend the limits of Naval Petroleum Reserve 1 to include all public lands within the same geologic structure. However, the question of condemnation of privately owned lands within the reserve has come up repeatedly in the hearings.

Stuart strongly defended the Navy's policy of cooperation with the Standard of California, on the bases that past operation has been successful, and that the desire of both Congress and the President had been to use condemnation only as a last resort after all other means of negotiation had failed.

As Stuart's testimony continued, the early inclination of several members of the committee toward condemnation lessened somewhat, although James F. O'Connor of Montana steadfastly held out for condemnation, even to the point of suggesting that the Navy had been quick to institute condemnation proceedings against "a small landowner" while continuing to allow Standard interests to operate in the field. The small landowner referred to was the Kern County Land Co., against which, it was pointed out, 53 per cent of the county's taxes are assessed.

Rep. Compton I. White, of Idaho, objected frequently to the policy of the Navy allowing Standard of California to produce oil from the reserve which the Navy later buys at market price. "You can get oil as cheaply from any marketer as from your own reserves," he told the witness, and suggested that oil from the Naval Reserve was going, ultimately, into civilian consumption.

Rep. Alfred J. Elliott, of California, objecting strongly to the idea of condemnation of private lands, brought out the point that the extension of the limits of the reserve to include the geologic structure of the Elk Hills area might take in considerable territory, since engineering data is extremely limited.

"Condemnation," he said, "might cost the nation millions of dollars, all because somebody's got a grudge against the Standard Oil Co."

Standard Contract Defended

Rep. J. Edgar Chenoweth, of Colorado, stated his approval of the present arrangement with Standard of California, the new contract, and the general policy in no uncertain terms. "All this discussion," he said, "looks to me like much ado about nothing."

Stuart testified that the attorney general had given the opinion that the privately owned wells in Elk Hills could not be taken over under the Second War Powers Act without closing down operation. The admiral added that he differed with the attorney general on that point, feeling that the wells could be taken over and operation continued.

The history of the Elk Hills problem goes back to the 1921 transfer of naval oil reserves to the Department of the Interior and subsequent private exploitation. The reserves were restored to the Navy in 1927. Through the act of June 30, 1938, provision was made for termination of then existing leases in the reserve at expiration date. This act is up for amendment, in the bill now under consideration. The 1938 act allowed Navy to enter into contracts for the development of the reserve, enter into compensatory royalty agreements with private interests, exchange government lands for private lands, or, if none of these could be done, to acquire ownership of private lands by purchase or condemnation.

Chief stumbling block has been lack of data for evaluating private holdings. In 1940 the U. S. Geological Survey began evaluation studies in the Elk Hills area, and Navy and the Standard of California began negotiations for exchange, purchase and operation.

Since that time, various proposals have been made leading to a tentative agreement in 1942 whereby 10 per cent of the oil would be produced, and 90 per cent conserved. Finally, a contract which was expected to lead to the purchase of Standard of California's holdings was drawn up in 1942, and later rescinded. Currently, the reserve is being operated by Standard of California for the Navy under a recission contract of 90 days, with an extension which terminates March 8, 1944.

Hearings are continuing before the House public lands committee, and it is expected that the House naval affairs committee will also hold hearings on the entire Elk Hills situation.

Caribbean Oil Shipments to Spain Halted for Month

WASHINGTON, D. C. — Oil shipments to Spain from the Caribbean area have been suspended by the United States for February as part of a general reconsideration of Spain's position in the war. Matters involved include Spain's failure to release Italian ships interned in her ports, to control adequately German agents operating in her territory, and reduce export of war materials to Germany.

The American action follows British protests to Madrid over activities of German spies and saboteurs alleged to be operating on Spanish territory, especially near Gibraltar.

Spain's oil supplies for next month were withheld by this government's cancellation of loading dates at Caribbean ports for February Under the system by which Spain has been receiving the oil the yearly quota is apportioned by months, and dates are set on which Spanish tankers may load oil at the Caribbean ports. Three such dates were set for February. Spain has a fleet of about 14 tankers which regularly carry on this trade.

Specific Ceiling Prices Placed On Middle West Products to East Coast

WASHINGTON, D. C.—Bulk lots of gasoline, kerosene and distillate fuel oils shipped from Ohio, nearby points in Kentucky and Indiana, and from Michigan to the eastern seaboard area have been covered with cents-per-gallon ceilings, the Office of Price Administration announced this week.

These shipments, which are made by refiners and terminal operators in rail tank cars, pipe lines and inland barges, are the result of wartime disruption of the normal tanker routes.

Retail prices of these products on the East Coast will not be affected, but the action will be of aid to each shipper in quickly determining his maximum prices.

FROM OHIO AND NEARBY KENTUCKY AND INDIANA AREAS TO DISTRICT 1 AND MICHIGAN*

Gasoline

(Cents per gallon)

	Price Area G	I	J-1	K-1
80-82 oct. A.S.T.M. and Ethyl	8.375	8.625	8.750	8.750
72-74 oct. A.S.T.M.	7.375	7.625	7.750	7.750
Kerosene and Distillate Fuel Oils				
41° W.W. kerosene	5.500	6.125	6.250	6.250
No. 1 B.W. distillate (fuel oil) range and stove oil and No. 1 fuel oil	5.375	‡5.625	5.750	§6.125
No. 2 fuel oil	5.250	‡5.500	5.500	§6.000
No. 3 fuel oil	5.125	5.500	5.500	§6.000

*Maximum prices† in bulk lots loaded into transportation facilities f.o.b. shipping points in areas designated above for shipment to ultimate destinations in PAW District 1 and Michigan.

†Sellers of No. 1 P.W. distillate, range oil and No. 1 fuel oil shipping from Price Area J-1 for destinations other than PAW District 1 and Michigan are permitted by this amendment to use either the price listed herein, or a price permitted under other provisions of this price schedule.

‡For Boyd County, Kentucky, add 0.125.

§For Stark County, Ohio, deduct 0.25.

Price Area G comprises the counties of Union, Henderson, Davies, Hancock, Breckinridge, Meade, Hardin, Bullitt, Jefferson, and Oldham in Kentucky; and the counties of Posey, Vanderburgh, Warrick, Spencer, Perry, Crawford, Harrison, Floyd and Clark in Indiana.

Price Area I comprises the area within a radius of 25 miles of Indianapolis, Ind., the counties of Hamilton, Clermont, Brown, Adams, Scioto, Lawrence, Gallia, and Meigs in Ohio; and the counties of Boone, Kenton, Campbell, Pendleton, Bracken, Mason, Lewis, Greenup, and Boyd in Kentucky.

Price Area J-1 comprises the counties of Allen, Hancock, Lucas, Putnam, Wood and Licking in Ohio.

Price Area K-1 comprises the counties of Cuyahoga, Lorain, Medina, Summit, Stark, Portage, Geauga, Lake, Ashtabula, Trumbull, Mahoning and Columbiana in Ohio.

FROM MICHIGAN TO DISTRICT 1*

(Cents per gallon)

Gasoline

	Price Area J-2	H-2
80-82 oct. A.S.T.M. and Ethyl	9.00	8.75
72-74 oct. A.S.T.M.	8.00	7.75
67-69 oct. A.S.T.M.	7.25	7.00
Straightrun	6.00	6.00
Kerosene and Distillate Fuel Oils		
46-49 W.W. kerosene	6.25	6.00
41-45 W.W. kerosene	6.00	5.75
No. 1 P.W. distillate	5.75	5.50
No. 2 fuel oil	5.50	5.25
No. 3 fuel oil	5.25	5.00

*Maximum prices in bulk lots loaded into transportation facilities f.o.b. shipping points in areas designated above for shipment of ultimate destinations in PAW District 1.

(Range or stove oil shall take the maximum price of the product listed above of the same specifications.)

Price Area J-2 comprises Wayne and Monroe counties in Michigan.

Price Area H-2 comprises the State of Michigan (excluding Wayne and Monroe counties).

Previously, the ceilings were established by application of a "freeze" formula and were generally based on the individual sales to destinations other than eastern seaboard points. As a result, the ceilings have varied considerably even at a given shipping point, and inequities to buyers and sellers have occurred.

The new uniform ceilings reflect the general level of returns to sellers received on sales in their normal marketing areas during the October 1941 base period.

Two New Tankers Replace Four Obsolete Vessels

WASHINGTON, D. C. — Two new 141,000-bbl. (T2 - SE - A1) tankers, scheduled to be completed by the middle of February, will join the fleet of The Texas Co., the Maritime Commission announced last week. They are being built at the Sun Shipbuilding & Dry Dock Co., Chester, Pa.

The commission said The Texas Co. was buying the new tankers at wartime construction costs, less the cost of national-defense features, and was asking for no construction or operating subsidy. A trade-in credit of $2,498,580 for four obsolete tankers as down payment on the purchase price of $6,000,000 for the new vessels was allowed. The settlement on the balance, plus 3½ per cent interest, will be secured by a mortgage and payments will be due in 15 annual installments.

The four old vessels have a combined deadweight tonnage of 39,660 as compared to 33,310 for the two new ships. Other comparative statistics are, respectively: Gross tonnage, 25,612 and 20,344; cargo capacity in barrels of gasoline, 300,000 and 282,316; speed in knots, 10 and 14½.

Approval of the commission for the trade-in specifies that the old vessels, now under time charter to the War Shipping Administration, are to be available for delivery within 10 to 30 days after notice.

The vessels will be transferred to WSA by the commission for operation on behalf of the Government to the extent deemed necessary during the war emergency.

Petroleum Retail Price Ceiling Rules Revised

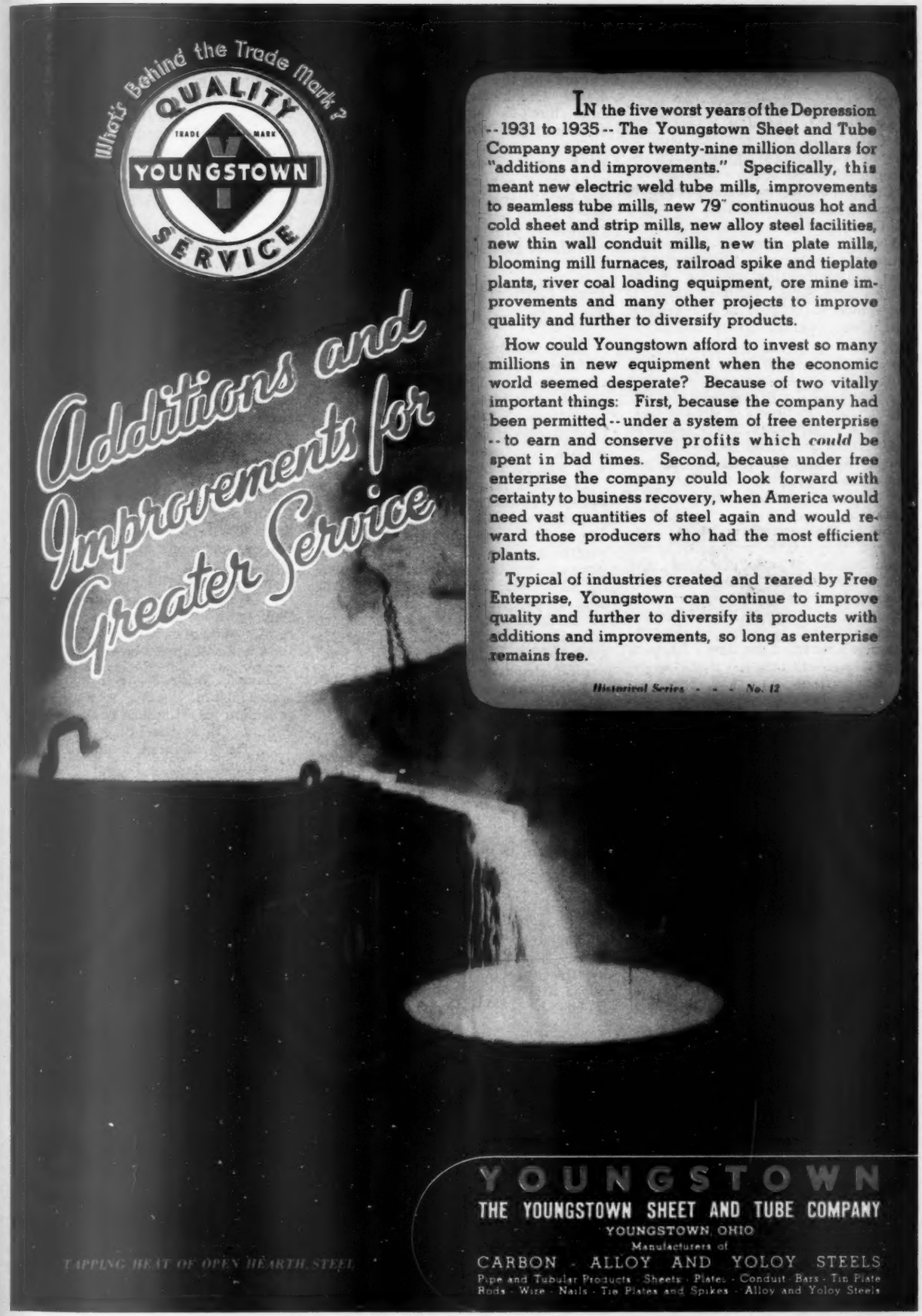
WASHINGTON, D. C.—Provisions for determining ceiling prices of petroleum products sold at retail were condensed and simplified by the Office of Price Administration January 28. This was done by revising the original retail petroleum products regulation that became effective in May 1942, and bringing it up to date with the incorporation of the various amendments issue since that time.

The revised regulation covers all sales and deliveries at service stations and other retail establishments of the following petroleum products: motor fuel, motor lubricating oil, greases, kerosene, prime white distillate, Nos. 1 and 2 fuel oil and range oil, and cleaner's or other naphthas. Greases were added to the list in the revision.

Bayway Refinery Unit Sets Operating Record

LINDEN, N. J.—The Bayway refinery of the Standard Oil Co. of New Jersey set a new local war production record of uninterrupted processing of crude petroleum when its No. 3 pipe still last week completed 8 months' operation without a shutdown. The previous Bayway record was 6 months.

In its present run, which is still unbroken, the record-breaking pipe still has processed over 10,000,000 bbl. of crude petroleum. D. L. Ferguson, general superintendent of the Bayway refinery, credited the record to improved facilities and greater effort on the part of employes to get maximum war output from equipment.


What's Behind the Trade Mark?
QUALITY
TRADE MARK
YOUNGSTOWN
SERVICE
Additions and Improvements for Greater Service
IN the five worst years of the Depression -- 1931 to 1935 -- The Youngstown Sheet and Tube Company spent over twenty-nine million dollars for "additions and improvements." Specifically, this meant new electric weld tube mills, improvements to seamless tube mills, new 79" continuous hot and cold sheet and strip mills, new alloy steel facilities, new thin wall conduit mills, new tin plate mills, blooming mill furnaces, railroad spike and tieplate plants, river coal loading equipment, ore mine improvements and many other projects to improve quality and further to diversify products.
How could Youngstown afford to invest so many millions in new equipment when the economic world seemed desperate? Because of two vitally important things: First, because the company had been permitted -- under a system of free enterprise -- to earn and conserve profits which could be spent in bad times. Second, because under free enterprise the company could look forward with certainty to business recovery, when America would need vast quantities of steel again and would reward those producers who had the most efficient plants.
Typical of industries created and reared by Free Enterprise, Youngstown can continue to improve quality and further to diversify its products with additions and improvements, so long as enterprise remains free.
Historical Series - - - No. 12
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THE YOUNGSTOWN SHEET AND TUBE COMPANY
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Manufacturers of
CARBON - ALLOY AND YOLOY STEELS
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Rods - Wire - Nails - Tie Plates and Spikes - Alloy and Yoloy Steels

Creole Considering Venezuelan Refinery

NEW YORK. — Construction of a 40,000-bbl. per day refinery on the Caribbean at or near La Guaira, port of Venezuela's capital, Caracas, is reported to be under consideration by Creole Petroleum Corp., Venezuela operating affiliate of Standard Oil Co. (New Jersey).

Another pipe line from eastern Venezuela fields to the Caribbean seacoast, supplementing capacity of the Oficina and Santa Barbara lines, is understood to be part of the general expansion program under consideration.

A five-man committee, headed by John Kalb, was to have left last week for Venezuela to investigate the situation. Other members of the committee are J. E. Lindroth, M. G. Gamble, E. H. Kares and Brian Mead. Earlier George W. Gordon, head of the foreign refining department of Standard, had visited Venezuela on a similar mission.

This is the second report of postwar refinery construction in Venezuela. Earlier it was disclosed that Sinclair Oil Corp., through its subsidiary, Venezuelan Petroleum Co., had purchased a refinery site at Puerto la Cruz, terminal of its 100-mile pipe line from the Santa Barbara field.

Lion Oil Plans to Start Well Operations in Nova Scotia

NEW YORK.—Lion Oil Refining Co., El Dorado, Ark., is planning to start drilling operations in Cape Breton, Nova Scotia, as soon as weather conditions permit. Col. T. H. Barton, president of the company, said here that exploratory licenses obtained cover more than 800 sq. miles. The proposed drilling operations follow geophysical and geological work.

In commenting on Lion's exploration program, Colonel Barton pointed out that the Nova Scotia project is in line with one of the company's announced major objectives for 1944, namely, the development of additional crude-oil reserves. He said that the company was operating under a license issued by the government of Nova Scotia under its Petroleum and Natural Gas Act of 1942.

Advance in Lance Creek Oil Price Authorized by OPA

WASHINGTON, D. C. — Ceiling price of crude oil of 40 gravity or higher in the Lance Creek, Wyo., field has been advanced from $1.12 a barrel to $1.25 through an amendment issued by the Office of Price Administration. The amendment increased the price in the Salt Creek field 5 cents and places both fields on the Mid-Continent basis.

Part of the production from the Lance Creek field is delivered by pipe line to the Standard Oil Co. (Indiana) at Whiting, Ind., and is sold in competition with Mid-Continent oils.

Lance Creek crude has been selling for 12 cents and Salt Creek crude for 5 cents a barrel under the Mid-Continent price. The new rule will not affect existing contracts, he said.

First National Bank's 1943 Deposits at All-Time High

Deposits rose to an all-time high in The First National Bank & Trust Co. of Tulsa in 1943, totaling $93,980,-245.83. This was an increase of approximately $20,000,000 during the year, most of it in commercial accounts. A substantial increase in savings was recorded also.

The most important change in the bank's capital account was the increase in surplus of $1,000,000, which was transferred from the undivided profits account in January. At the year's close the bank had a capital of $2,000,000, surplus of $3,000,000, and undivided profits and reserves of $1,126,237.12, the annual report, submitted by R. Otis McClintock, president, reveals. This makes a total capital structure of $6,126,237.12.

Total loans showed a small gain over those of 1942. There was a marked slackening in credit requirements from the oil industry and to a lesser degree from other general credit-seeking sources, but financing for war-production purposes more than offset declines in other fields.

Giddens Is Named Curator Of Drake Memorial Park

TITUSVILLE, Pa.—Appointment of Dr. Paul H. Giddens, Meadville, Pa., as curator of Drake Well Memorial Park, Titusville, has been approved by the governor's office, in Harrisburg. Since Dr. Giddens is head of the department of history and political science at Allegheny College, he will serve as curator on a part-time basis.

The appointment was recommended by the Drake Well Memorial Park Advisory Board last July, and Pennsylvania Historical Commission approved the recommendation.

The members of the Drake Well Memorial Advisory Board, appointed by American Petroleum Institute, are Charles B. Stegner, chairman; J. M. Bloss, vice chairman; William H. Scheide, secretary; Edgar T. Stevenson, Titusville; Parke A. Dickey, Bradford, Pa.; Edward P. Boyle, Oil City, Pa., and Dr. Giddens.

DEATHS

William E. Ramsey, 54, vice president of Ramsey Petroleum Co., and pioneer oil operator of Oklahoma, died January 31 at his home in Santa Monica, Calif. He and his brother, Walter R. Ramsey, began operations at Ardmore, Okla. W. E. Ramsey helped develop the Long Beach field in California.

E. W. Criswell, 58, secretary and director of National Tube Co., died January 28 at his home in Pittsburgh, Pa. Criswell became general attorney, secretary and director of Oil Well Supply Co. in Pittsburgh in 1924. He continued with that organization when it became a United States Steel Corp. subsidiary in 1930, and in 1932 he was sent to Dallas, Tex. He returned to Pittsburgh when he was elected to his position with National Tube in 1936.

Dr. Arthur J. Tieje, professor of geology at University of Southern California, died January 25 in Pasadena, Calif., following an operation. He was president of the Pacific section of Society of Economic Mineralogists and Paleontologists, and a member of the American Association of Petroleum Geologists. In recent years he did special research work for the Indian Geological Survey in Burma.

Dave L. Riley, 39, technical adviser and assistant to the executive vice president of Hughes Tool Co., died January 25 at his home in Houston, Tex. He graduated from University of Illinois in 1924 with a degree in mechanical engineering.

Luther M. Moyer, 66, former vice president in charge of sales of Linde Air Products Co., died January 25 at his home in Montclair, N. J.

Theodore S. Schroeder, 60, Dallas, Tex., oil man, died January 27 as he sat down to luncheon at the Dallas Athletic Club. Pioneer operator and drilling contractor in the East Texas fields, Schroeder went to Dallas from Shreveport, La., 16 years ago.

Jess Francis Waters, 31, employed in the geophysical department of Shell Oil Co., Inc., for the past 10 years, died January 26 at his home in Houston, Tex.

Richard Jennings, field engineer for Oliver United Filters, Inc., died January 23 in Lawrence, Mass. His home was in Brunswick, Ga.

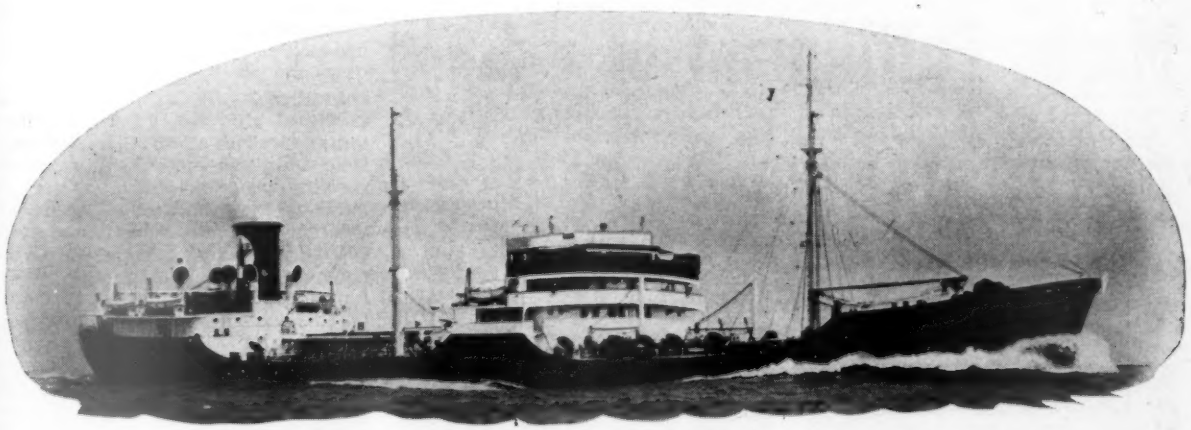
Robert C. Flourney, 72, identified with the oil-equipment business since about 1900 until his retirement 5 years ago, died January 20 at his home in Los Angeles, Calif. His work carried him to virtually all oil areas in this country and to many in foreign lands.

TO SPEED VICTORY

SUN SHIP IS PROUD OF THE EQUIPMENT BUILT FOR THE SUN OIL CO.'S FAMED PLANT NO. 15 WHICH IS PLAYING SO GREAT A PART IN AMERICA'S AVIATION GASOLINE PROGRAM.

SIMILAR EQUIPMENT HAS BEEN AND IS NOW BEING BUILT IN OUR SHOPS FOR MANY OTHER OIL COMPANIES TO SPEED FACILITIES TO INCREASE FUEL PRODUCTION FOR THE AIR FLEETS OF THE UNITED NATIONS.

THE SUN SHIPYARD AT CHESTER IS FOREMOST BUILDER OF TANKERS — ALSO BUILDERS OF OTHER TYPES OF SHIPS — MARINE REPAIRS, DRY DOCKING AND DIESEL ENGINE BUILDERS.



The Tanker "OHIO" built by SUN SHIP for The Texas Co. withstood Axis torpedoes and air bombing to deliver desperately needed cargo to Malta.

SUN SHIPBUILDING & DRY DOCK CO.

CHESTER, PA.

Completion of 15 Plant Marks Fulfillment of PEARL HARBOR PLEDGE

by J. Howard Pew
President, Sun Oil Co.

COMPLETION and successful operation of Sun Oil Co.'s 15 Plant for the manufacture of 100-octane aviation gasoline marks the fulfillment of a pledge made at the time of Pearl Harbor to reconstruct the Marcus Hook refinery so as to produce the maximum possible quantity of war products.

15 Plant is the latest link in Sun Oil Co.'s program for the conversion of its refinery facilities to the fullest possible war basis. Construction of this plant, at a cost of $13,000,000, completed the company's original war-conversion program and cleared the way for the start of a second plan which is now making rapid progress.

Actually our company took the first steps more than 10 years ago in preparation for this war, unforseen though it was at the time. This was in the summer of 1933 when Sun's technicians started the engineering developments which resulted in the commercialization of the Houdry catalytic-cracking process.

There is no doubt that without the principle of catalytic cracking and its commercial development, the 100-octane-aviation-gasoline program, in the huge volumes required by this war, would have been impossible. Sun's technicians early recognized the importance of catalytic cracking in the production of high-octane gasolines necessary not only for the improvement of motor-car performance but for the future of aviation.

Sun Oil aggressively pushed the development of the Houdry catalytic-cracking process, and on March 15, 1937, placed in commercial operation the first large catalytic-cracking unit in the world. Several more units were in operation when war broke over Europe. In 1940 Sun started operating the first catalytic-cracking unit specifically built for the production of high-octane aviation gasoline. This production was for the account of the British and the French. On the day the Japs attacked the United States fleet at Pearl Harbor, Sun Oil Co. at Marcus Hook had the largest catalytic-cracking capacity of any refinery in the world.

Converted to War

It was then our company made a pledge to convert these catalytic-cracking facilities from motor-gasoline production to aviation-gasoline base stock as speedily as humanly possible. Likewise we pledged ourselves to convert other facilities at Marcus Hook in such a manner as to obtain from them maximum war products. Within a few weeks after Pearl Harbor, Sun Oil tripled its prewar production of aviation-gasoline base stock and in 4 months raised its production to approximately five times the prewar figure.

15 Plant, with its fine alkylation facilities and its gas-fractionation unit, as well as another Houdry catalytic unit, completed the aviation-gasoline program which we had in mind at that time. As a result the aviation-gasoline production of Marcus Hook today is roughly in the neighborhood of 20 times the prewar figure. Stated another way, it is sufficient every day to propel 500 four-engine bombers from England on raids over Berlin and return.

Naturally the men and women of the Sun Oil Co. are proud of 15 Plant and they are pleased that it has attracted such wide attention. They particularly take pride in the fact that the construction of this plant, as well as all of the Marcus Hook war-conversion program, resulted from the individual initiative of free men and that it was financed entirely by our company. Finally, they are proud of the great contribution which collectively they have made and are making to the ultimate victory of the Allied Nations that is now indicated.

ARTHUR E. PEW, JR., vice president in charge of manufacturing, Sun Oil Co.

J. EDGAR PEW, vice president in charge of production, Sun Oil Co.

J. N. PEW, JR., vice president, Sun Oil Co.

SUN'S MARCUS HOOK REFINERY IS ONE OF WORLD'S TEN LARGEST

SUN OIL CO.'s Marcus Hook refinery, with a crude-oil charging capacity of approximately 120,000 bbl. per day, ranks among the 10 largest petroleum refineries in the world. It is just 42 years old this month and during those 42 years its capacity has been increased 80 times. In February 1902 refining operations began when the Paraguay, the company's first tanker, delivered its initial cargo of crude to Marcus Hook. In 1903, the refinery's first full year of operation, its crude throughput averaged 1,500 bbl. per day.

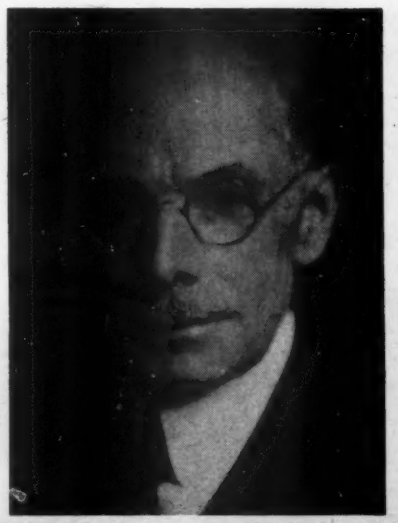
Today the Marcus Hook refinery is not only one of the world's largest but also one of the most modern. Contributing to this status is the most recent addition to its facilities, 15 Plant. This plant further increased the refinery's catalytic-cracking capacity, already the greatest in existence, and augmented that with the world's largest alkylation plant. These units, plus the auxiliary gas fractionation and stabilization section of the new plant and previously installed catalytic cracking and treating capacity, made possible a tremendous increase in Sun's production of today's superfuel for aircraft.

This refinery became the birthplace of catalytic cracking when the first Houdry unit went on stream 7 years ago. In July and August 1939, two 30,000-bbl.-per-day combination catalytic-cracking units began operation and 2 months later, the first two catalytic treater units were completed. In 1940, the first catalytic unit designed and built specifically for the production of 100-octane gasoline was put on stream. This gasoline was produced for the British and French armies.

Sun Oil Co. was founded in 1886. Though it is almost 60 years old, only two men have served as its principal executive officers: its cofounder, the late Joseph N. Pew, and his son who is now president, J. Howard Pew. The latter has been head of the company since his father's death in 1912. Other officers of the company today are: J. N. Pew, Jr., J. Edgar Pew, Arthur E. Pew, Jr., and S. B. Eckert, vice presidents; Frank Cross, secretary-treasurer, and Clarence Thayer, a director and chief engineer.

SAMUEL B. ECKERT, vice president, Sun Oil Co.

FRANK CROSS, secretary and treasurer, Sun Oil Co.



CLARENCE H. THAYER, chief engineer manufacturing department, and a director

Latest Addition to Sun Refinery

by J. P. O'Donnell

AVIATION gasoline meeting today's specifications of the military forces is, with the exception of a small amount of tetraethyl lead, a petroleum product. However, it is not available as such from crude petroleum but is built from hydrocarbon molecules that are first separated from the undesirable constituents of the crude oil and then converted or combined into components which are blended to make 100-octane fuel.

Therefore, fighting-grade aviation gasoline is, in reality, a synthetic chemical which is being manufactured on a scale vastly greater in complexity and volume than any undertaken by the chemical industry.

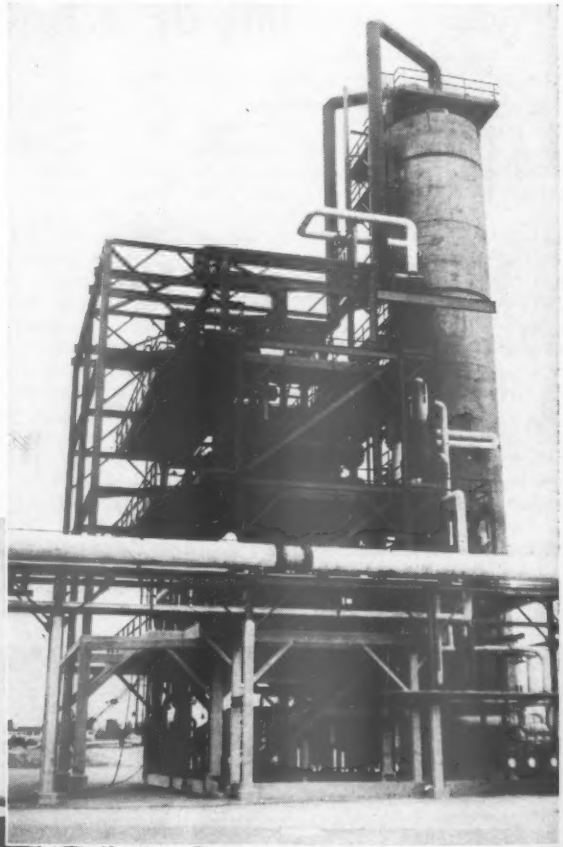
The complexity of this operation is shown, as far as security will permit, in accompanying articles describing the various units that comprise 15 Plant, the most recent addition to the Marcus Hook, Pa., refinery of Sun Oil Co. The tremendous volume involved is apparent from a recent record established by this plant and contributing facilities. Due to a combination of favorable circumstances it was scheduled to produce, in 1 month, sufficient 100-octane gasoline to fuel 1,000 Flying Fortresses or Liberators on 23 raids over Germany.

The principal constituent of 100-octane gasoline from the standpoint of volume is the base stock. The best-known means of producing base stock, with volume and quality considerations involved, is catalytic cracking Even before 15 Plant was completed, the Marcus Hook refinery, birthplace of catalytic cracking, housed the greatest such capacity in the world. This enabled it to produce a very large proportion of the base stock that was available to this country and its Allies prior to the industry-wide expansion program that is now coming into fruition.

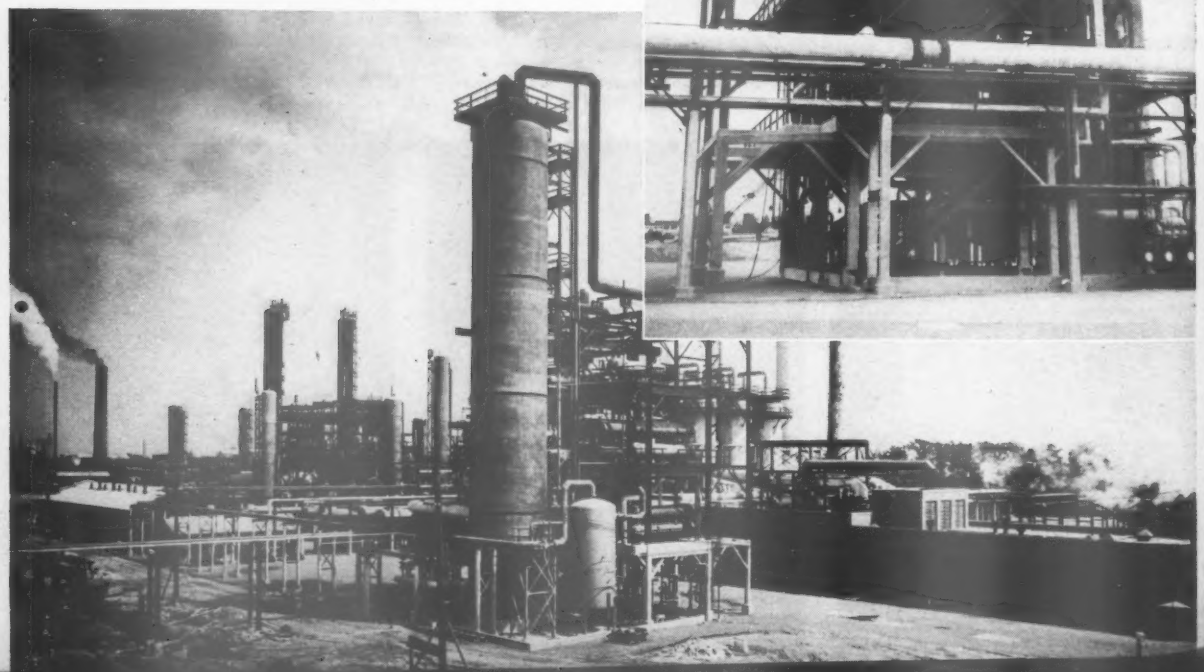
With the completion of 15 Plant the company effected a truly remarkable increase in its output of 100-octane gasoline. The principal unit of the new plant is a six-case Houdry catalytic treater, the first unit designed and built especially for that purpose. It had been recognized for some time that the second-pass treating of first-pass catalytically cracked base stock resulted in better yields, particularly from the standpoint of antiknock quality. This was demonstarted in the original three-case unit at Marcus Hook which had been in service many months as a treater. The experience gained in the operation of this smaller plant led to the design and construction of 15 Plant's dominating unit.

Second most important constituent of 100-octane gasoline, on a volume basis, is alkylate. Alkylate, resulting from the reaction of light petroleum fractions unsuitable for inclusion as such in aviation gasoline, is utilized to increase the volume of 100-octane gasoline. By imparting high antiknock characteristics and improving

Products from the catalytic cracking unit are fractionated in this large-diameter tower



General view of 15 Plant with fractionating tower of Houdry catalytic treating unit in the foreground



Greatly Swells 100-Octane Output

the lead susceptibility it permits the use of lower-quality base stock. Since improvement in quality normally is accompanied by a decrease in quantity, ability to use a lower octane base stock enables the production of larger volumes. Facilities in existence at Sun's refinery were capable of producing 100-octane fuel without alkylate but a unit for its production was installed to effect an increase in the total production.

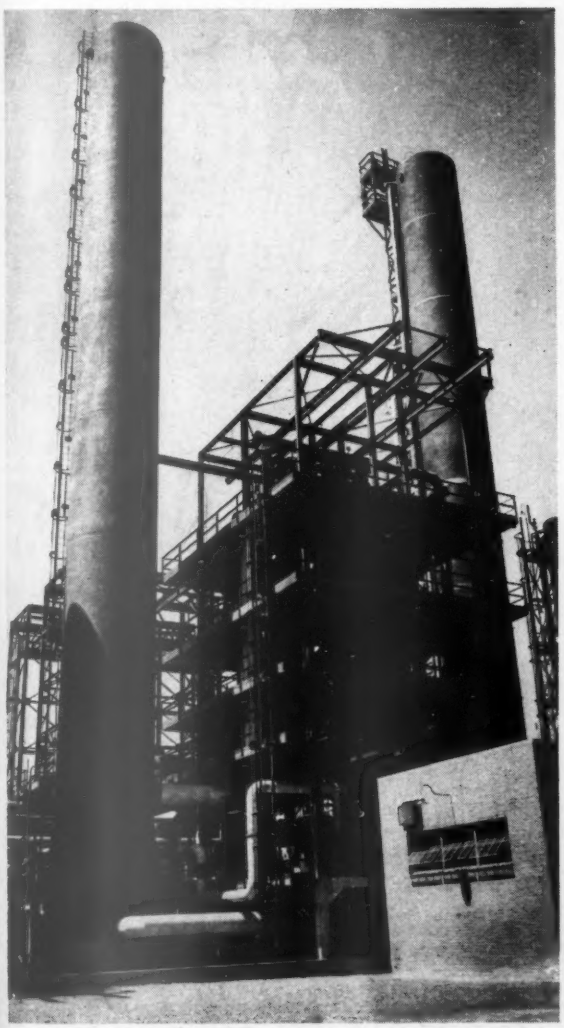
Inclusion of an alkylation unit required the installation of facilities for gathering, stabilizing and fractionating the gases from which alkylate is manufactured. Houdry units, as operated at Marcus Hook, have been described as a veritable mint of isobutane. This material with butylenes obtained from catalytic and thermal cracking and reforming were available in sufficient quantities to justify erection of the world's largest alkylation unit. The light ends which go to make up the charge are combined and then successively deethanized, depropanized and debutanized. Overhead from the final fractionation constitutes feed for alkylation.

Erection of facilities such as those included in 15 Plant was accompanied by a need for expansion of utility sources. Accordingly a boiler plant and water plant were included and an electric power substation was added. Laboratories sufficient to house the necessary plant-control personnel and equipment were also erected. The existence of these facilities makes 15 Plant a complete gasoline refinery though it is improbable that it will ever operate as such.

The addition of 15 Plant enabled the Marcus Hook refinery to increase its crude-oil charging capacity to approximately 120,000 bbl. per day and made it one of the few of the hundreds of refineries in the United States that are capable of processing in excess of 100,000 bbl. per day. Only three refineries outside this country have a greater capacity.

Since already existing refining units and tankage occupied all available space at the established site of the Marcus Hook refinery it was necessary to build 15 Plant on an entirely separate location. Accordingly a tract of 123 acres, about 1 mile south of the existing refinery and separated from it by property of Pure Oil Co., was obtained. This was the only convenient site in the immediate area that was large enough to accommodate the units comprising the plant. The new and old plants are operated in conjunction so it was necessary to install some 30 individual lines, each about 1 mile in length, to tie in the joint operation.

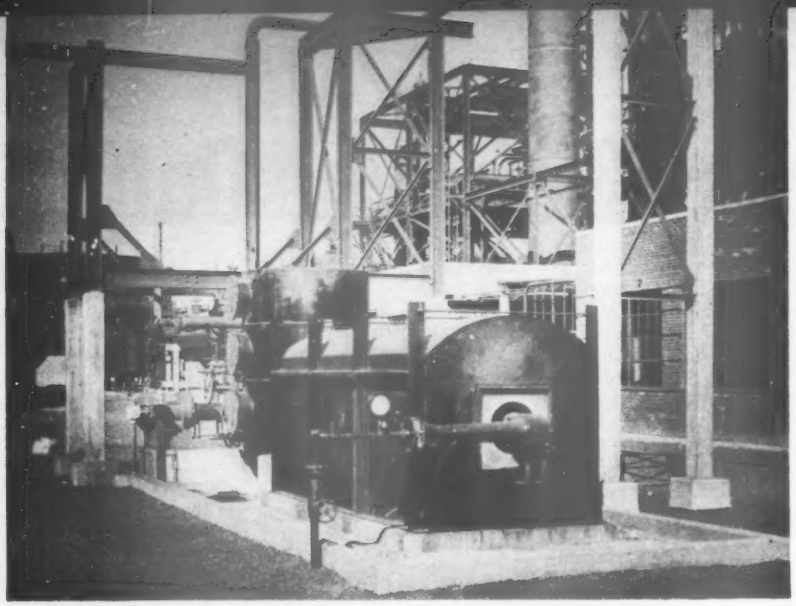
Deisobutanizer towers, 150 ft. tall, dominate UOP alkylation unit



Functioning of Plant

The functioning of 15 Plant may be visualized by reference to the accompanying flow diagram combining the various units. The charging stock consists principally of single-pass base stock produced in other catalytic-cracking units at Marcus Hook and at the company's Toledo, Ohio, refinery. Before 15 Plant came into existence the company had eight catalytic-cracking units at these two refineries, five at Marcus Hook and three at Toledo, all engaged in the aviation-gasoline program. At present, under nor-

Flow of refinery gas to the gas plant is controlled by the gas manifold seen below



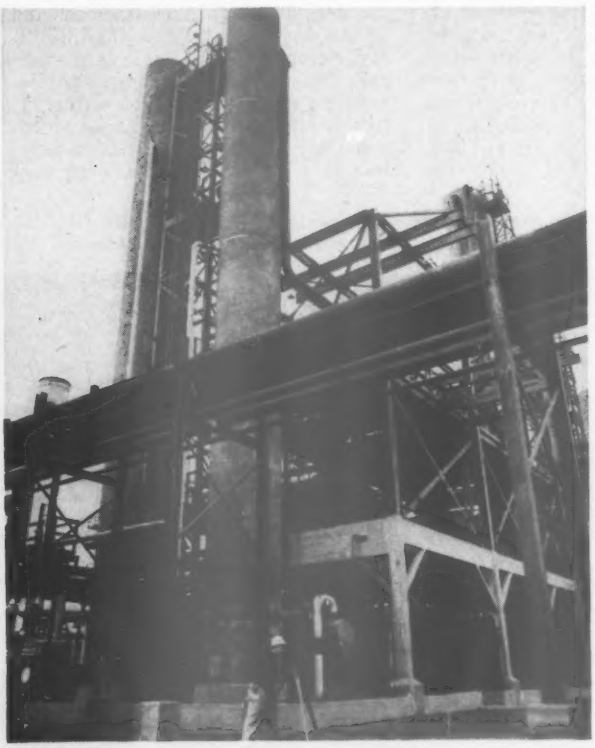
Among the unusual safety precautions at 15 Plant is this CO_2 generator. The CO_2 is used to purge vessels of dangerous gases

mal operation, four of the Marcus Hook units are producing first-pass base stock, one is second-pass treating and one is engaged in CTC processing. In the latter process, a highly aromatic blending agent is produced by the thermal cracking of high-boiling-point naphthas from first-pass units and the subsequent catalytic treating of the thermally cracked product.

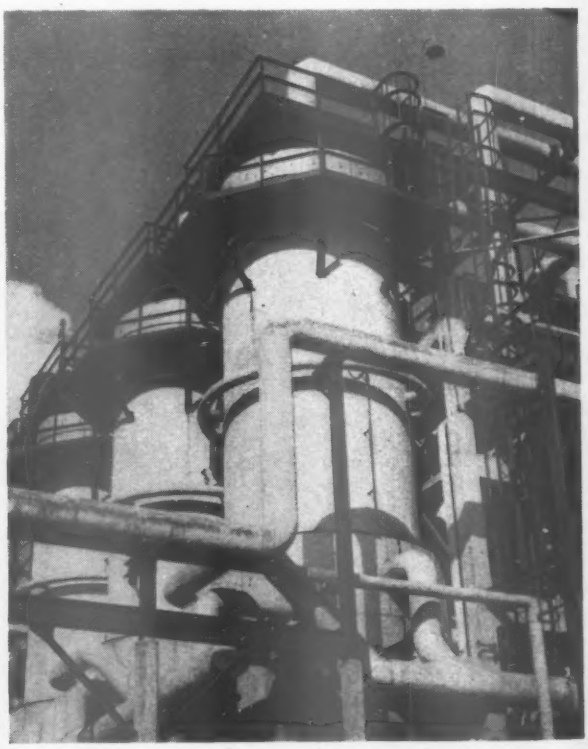
All of the units which antedated 15 Plant were built primarily for motor-gasoline production or first-pass base with block operation for second-pass treating. Experiments had shown that second-pass treating resulted in the removal of undesirable olefins and improved the quality of the base stock. However, this operation required running space and to do it in existing facilities would result in a decrease in first-pass production equal to the amount that was rerun. Therefore the construction of the 15 Plant catalytic-treating unit, capable of second-pass treating the entire first-pass production of other units, was undertaken.

The Houdry unit in the new plant is essentially the same as its predecessors and may be used for any of the functions which the others perform: catalytic cracking of gas oil, treating first-pass base stock or for the final catalytic step in CTC processing. It is a six-case unit though space is available and auxiliary facilities are designed to accommodate a doubling of capacity later. When that takes place it will equal the latest 12-case unit at Marcus Hook, designated as 10-3, the largest single catalytic-cracking unit in existence. The capacity of 10-3, operating on gas oil, is in excess of 20,000 bbl. per day.

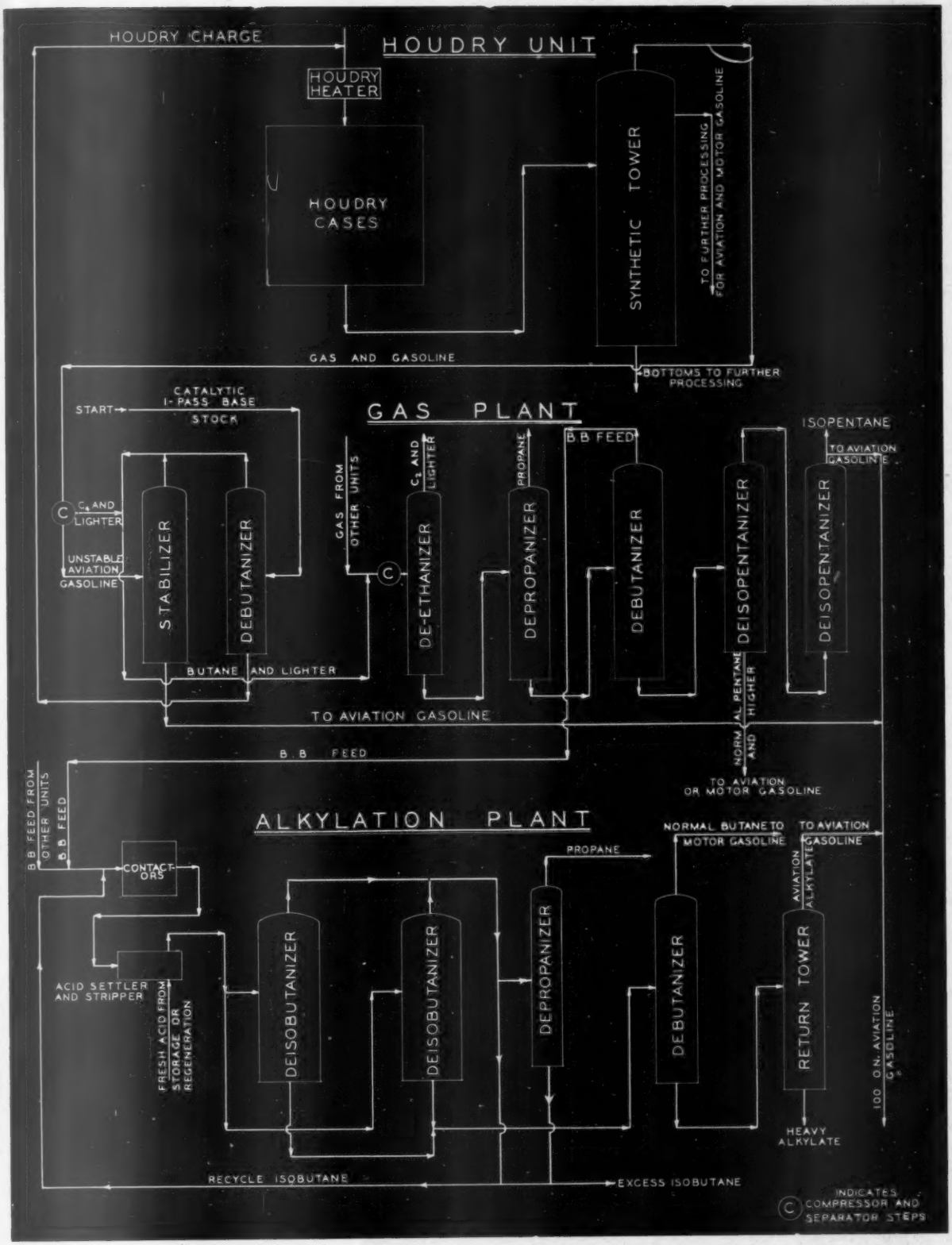
Thus the capacity of the six-case, 15 Plant unit, on the basis of a gas-oil charge, is 10,000 bbl. per day. From criteria obtained in the operation of earlier units it is known that, in this operation, it could produce about 3,000 bbl per day of first-pass base stock. Capacity when operating as the final step in CTC processing would be reduced to about 8,000 bbl. per day due to the more severe operating conditions required. Since the least severe conditions are necessary in second-pass treating, its capacity in this operation will be much larger—about 20,000 bbl. per day of first-pass stock. This will be increased to 22,000 bbl. per day when a Thermofor



Isopentane, a desirable 100-octane blending agent, is produced in the split deisopentanizer columns of the gas unit



Close-up view of three of the six catalyst cases that are a part of 15 Plant's catalytic-cracking unit



Schematic flow diagram of Sun Oil Co.'s 15 Plant

catalytic-cracking unit at Marcus Hook, now under construction, adds to the volume of first-pass stock.

Another product of the second-pass treater in 15 Plant is a B-B cut which constitutes part of the feed for the alkylation unit. Because of the fact that first-pass gasoline is debutanized before treating, the B-B volume obtained in the treating operation is, compared to the production of 10-3, small. These products are separated in a stabilizer, the overhead going to the alkylation plant and the bottoms, finished base stock, going to blending tanks in the older section of the refinery.

The main source of gas handled in the gas fractionation and stabilization section of 15 Plant is the 10-3 unit while the catalytic treater at the new plant provides a secondary source. Both the wet gas and unstable gasoline from the catalytic gas-oil cracking unit are subjected to an equilibrium contact operation. This stream is combined with that from the catalytic treater and compressed to 450-500 lb. per sq. in. in the compressor section. This high-pressure stream is then charged to the first of a series of fractionating towers.

Ethane and lighter gases are removed in the deethanizer, the bottoms of which are charged to the depropanizer and the depropanizer bottoms are then debutanized. The debutanizer provides the alkylation-plant feed, a fraction very rich in isobutane. Bottoms from the debutanizer are deisopentanized by fractionation in a split column which yields an overhead cut of isopentane and deisopentanized bottoms which are usable as motor naphtha.

The split column is one of the unusual features of 15 Plant. It was divided, because of the almost impossibly great height required, into two 80-ft. sections. Vapors pass from the top of the first section to the bottom of the second and liquid from the bottom of the second section is pumped to the top of the first.

The isopentane produced in this unit constitutes a highly desirable 100-octane blending agent in itself and, since the production is in excess of Sun Oil Co.'s own requirements, a considerable quantity is available to other refineries which are deficient. Another product of the gas plant is the C_3 fraction produced in the depropanizer. This fraction is disposed of commercially as liquefied petroleum gas.

The alkylation unit employs U.O.P. hydrogen fluoride process and, because of the ample quantities of butane-butene fraction available, it is the largest yet built. In order that the charge may be sweet and dry, it is caustic washed and dried by passing through bauxite beds. Due to previous fractionation, the streams composing the B-B feed have a low mercaptan content and a single-stage caustic wash is regarded as sufficient. Three bauxite drying towers are included so that while two are in use the third is being regenerated.

Reaction may take place in one or both of two sets of three reactors. One set is arranged to operate in parallel and the other in series. In either case the effluent is discharged to a decelerating settler from which an oil-free acid is recirculated to the contactors. The reaction of isobutane and butylene in the presence of hydroflouric acid is exothermic, approximately 600 B.t.u. being liberated per pound of olefin alkylated. In order to remove this heat, a water circulating cooling element is located in each reactor.

Overflow from the decelerating settlers contains about 1 per cent acid which is removed by distillation in a stripping column. Bottoms from the tower are defluorinated by contact with bauxite. Experiments with catalytic defluorination are now in progress.

The acid-free product of the reaction is charged continuously in parallel to two deisobutanizer towers. Erection of these towers, each 150 ft. high and weighing 300 tons, entailed an unusual engineering problem in itself. Overhead from the deisobutan-

This storage vessel was welded to the bed of the specially designed railroad carriage for transportation to the site of 15 Plant

Part of storage facilities are seven 40,000-bbl. Hortonspheroids, some of which are shown here

izers is recycled to the contactors where an excess of isobutane over butylene in the ratio of from 5 to 1 to 8 to 1 must be maintained so that the highly reactive olefins will react with the isoparaffins in preference to reacting with each other.

Propane removal is effected by taking a drag stream from the isobutane tower overhead to a small depropanizing column. Alkylate from the bottom of the isobutane tower still contains some normal butane which is removed in a debutanizer. The olefin-free character of the propane and butane thus produced gives them added value. The debutanized alkylate is rerun in a column producing an overhead stream of aviation alkylate and bottoms which can be blended with motor fuel.

Acid strength is maintained by taking a drag stream from the acid phase of the decelerating settler and charging it to a stripping column. Overhead from the stripper is 95 per cent pure acid carrying a small amount of water which is removed in a silver-lined dehydration column which yields an anhydrous acid. Fresh acid is received at the plant through a small diameter pipe line from a neighboring chemical plant, another unusual feature.

Safety Precaution

Because of certain hazards involved in handling hydrofluoric acid, tankage for fresh acid storage is located in an isolated section of the plant. Storage facilities are equipped with all possible safety devices including a tank with capacity to receive the entire contents of the acid section in case of emergency. Operators are required to wear neoprene-sole shoes, neoprene gloves and nitrometer face masks when performing routine duties. Protective clothing such as rubber boots, neoprene pants and coat suits and hood masks are worn during repair work. In case of a serious break, diver-type suits equipped with outside air connections are available. All established safety precautions are taken at 15 Plant as well as some which are distinctive with Sun. The latter includes the CO_2 generator, used to purge dangerous gases from vessels, which is a feature common to all Sun refineries but distinctive in the industry.

Because of the infinite numbers of variables involved in an operation as complex as that resulting from Plant 15, the matter of control is a consideration of prime importance. Purity of the various streams must be insured and this can be attained only through their frequent and accurate analyses. Accuracy in calculations based on these analyses is also essential due to the fact that the volume throughput of the plant is so great that errors of a few percentage points in certain instances could result in substantial losses of highly valuable material.

Demand for 50,000,000 gal. per day of cooling water necessitated installation of large-diameter mains. Here the 48-in. line is being laid under a railroad

The entire stream from the catalytic treating cases is thoroughly analyzed at frequent, periodic intervals. This work is done by a so-called survey group composed of chemical engineers and assistants. Data thus provided on charge and product streams furnish information on the effect of operating conditions, determine the rate of catalyst deterioration and provide the development and engineering divisions with information which may lead to further improvement in yields or quality. Unusual control problems were presented by the alkylation unit with its liquid, gas and hydrofluoric-acid streams and the necessity for maintaining the proper isoparaffin-olefin ratio in the reactors. To assist in this phase a pilot plant which may obtain charging stock, recycle stock or acid direct from the commercial unit, has been installed.

Because of the utilities load imposed by the units comprising 15 Plant it was necessary to provide its own boiler plant and water treating systems. The boiler plant houses three 75,000 lb.-hr. capacity boilers producing 450 lb. per sq. in. steam which is used successively in 450, 180, 135 and 40-lb. systems. The boilers are preferentially gas-fired although they are equipped for handling oil which is used only when there is a gas deficiency.

A tremendous volume of water, approximately 50,000,000 gal. per day, is used by Plant 15. This water is obtained from the Delaware River through two 48-in. intake siphons extending 850 ft. into the river. It is passed through ⅛-in. mesh traveling screens before being delivered to the plant through a 48-in. main. Most of this water is used for cooling without further purification and is then returned to the river. Only that part used for makeup for the steam boilers, the barometric condenser cooling tower and other special jackets is chemically treated.

Unusual river conditions prevailing at Marcus Hook made it necessary to design a treating plant capable of purifying water that varies seasonally. During droughts, sea-water contamination is a factor. Droughts are followed by a period of high accumulated sewage content. The most severe sea-water contamination in the history of the refinery occurred immediately after 15 Plant went on stream. The treating processes employed at the water plant proved so efficient that only a slight powdery deposit was found in one of the boilers when it was subsequently opened for inspection, having operated continuously through 3 months of drought. The deposits were so slight that their removal by water flushing was not considered justified.

Besides these operating units, 15 Plant also has its own storage tanks. They include seven 40,000-bbl. spheroids, two 10,000-bbl. spheroids and seven floating roof charge and run-down tanks as well as the necessary separator and fuel tanks.

This description of 15 Plant gives some indication of its scope. Another indication is provided by its total cost, $13,000,000. The cost was borne entirely by the company, exceptional even in the oil industry which has called upon the Government to provide a smaller proportion of expansion costs than any other major industry. Sun officials and employes regard 15 Plant as a fulfillment of the pledge the company made on December 7, 1941, to utilize every resource at its command to produce for victory. However, expansion of war-products facilities at Marcus Hook has not ended with its completion—additional catalytic-cracking capacity and a large lubricating-oil plant are now under construction there.

Flow diagram of 15 Plant's Houdry catalytic treating unit

Houdry Unit Specifically Designed to Treat Aviation-Gasoline Base Stock

by John R. Bates

THE new Houdry unit at 15 Plant serves as a key unit in the plan of operations of the whole refinery for the production of high-quality aviation-base stock. It receives products from all other Houdry units in the refinery and brings them to the high quality which makes possible the use of small quantities of blending agents for the production of 100-octane-number aviation gasoline. It also furnishes to the gas plant at 15 Plant a stream of alkylate feed containing about 1,000 bbl. daily of isobutane. This material is a valuable component of the butane-butene stream being fed to the alkylation unit. Its availability in the refinery removes any necessity for a butane isomerization unit to take care of the olefins produced in the thermal-cracking units at the refinery.

The unit consists of six catalytic-cracking cases operating as three pairs. Two cases are continually on stream while the other four are being regenerated. The cases are charged with the new Houdry synthetic catalyst which is manufactured especially for the production of high-quality aviation products. The specific type of catalyst used was developed directly for the production of aviation-gasoline base stocks. Each case has a catalyst capacity of 34,000 liters and the unit as a whole contains about 125 tons of catalyst.

Although, as stated, the unit is specifically designed for the second pass or treating of aviation-gasoline base stocks, it has several possible alternate operations either on gas oil, first-pass base, or catalytic heavy naphthas. When operating on gas oil this unit has a throughput of better than 10,000 bbl. per day which is its nominal capacity at a space rate of 1.0 volume of oil per volume of catalyst. Although this unit has never been run on gas oil, it is known from commercial experience on other units that about 3,000 bbl. per day of good-quality aviation base stock could be produced with an octane number of 93-95. In spite of the high quality of this material it has been demonstrated that the unit contributes more to the production of 100-octane gasoline by using it in combination with the other Houdry units at the refinery by the production of highest-quality two-pass base stock. In this operation the unit is able to charge about 20,000 bbl. per day of first-pass catalytic gasoline. It is, furthermore, expected that it will be able to increase its throughput capacity to approximately 22,000 bbl. per day when additional base stock is available, after the completion of a large TCC unit which is, at the present time, being constructed at Marcus Hook and which will furnish base stock to be treated in this unit. The space rate of this operation will be 2.2. In a third type of operation the catalytic first-pass naphtha which would normally go to motor gasoline, after being thermally cracked, is fed to this unit at a reduced throughput to impose severe cracking conditions. The throughput capacity on this operation is about 8,000 bbl per day or 0.8 space rate. The intermediate thermal operation increases the production of base stock from the Houdry unit, as well as markedly improving the quality of the stock produced. This product (CTC aromatic blending stock) has a high octane and certain special blending qualities which produce fuels especially suitable for modern fighting aircraft.

John R. Bates, now an engineer with Sun Oil Co., is in his eighth year of association with the comparatively new art of catalytic cracking. Previous to joining Sun's technical organization in 1942 he had been engaged in research with Catalytic Development Co., the Houdry process operating company, since 1936 and in the last two of those six years, directed research.

Dr. Bates graduated from Amherst College in 1924 with a B.A. degree and obtained his Ph.D. from Princeton in 1927. He was a National Research Fellow at Johns Hopkins University in 1927-28 and at Berlin in 1928-29. From 1929 to 1932 he was a research associate at Princeton and during the next 4 years prior to his association with Catalytic Development Co., he served as an assistant and associate professor at University of Michigan.

Catalytic cases of Houdry unit

Control room showing panel board with control instruments and cycle timer

Flows

Oil flow.—A typical flow sheet of the unit is shown in Fig. 1. Charged to the unit it is fed to a heater brought to the desired temperature. It then passes over the catalyst in one of the cracking cases and to the synthetic-crude tower. Provision is made in the tower to take the gasoline and gas overhead and side streams of light naphtha and No. 2 furnace oil. The bottoms of the tower are heavy gas oil. It is possible to recycle one or more of these streams to the heater with the fresh charge. The gas and gasoline are separated, the gas passing to the neighboring gas plant and the condensate to the stabilizer tower, also in the gas plant. In this tower finished two-pass aviation gasoline is obtained as a bottom cut and the overhead gases are sent to the gas plant for inclusion in alkylate feed. The overhead cut is regulated to produce the vapor pressure required to blend this material with available blending agents to 100-octane gasoline meeting specifications.

Air flow.—The flow of air in regeneration is produced by a turbo compressor which receives its energy from flue gas coming out of the cases. Regeneration is carried out in the same time interval as that on stream and is accomplished at 45 to 50 lb. per sq. in. No outside power is required to furnish the air for regeneration. The changeover from oil to air flow in regeneration is accomplished by the usual motor-operated valves activated by the cycle timer entirely automatically. Between on-stream and regeneration are intervals during which the cases are purged of oil or air as the case may be. The purging is accomplished by evacuation of the cases by means of steam ejectors indicated on the flow diagram.

The complete cycle of operations is repeated 48 times a day in each reaction vessel. Neither oil nor air flows are interrupted as far as the unit as a whole is concerned; the cycle controller merely shifts streams from one reactor to another.

Salt flow.—Molten salt is circulated through the catalytic cracking cases as in other Houdry units to furnish heat for the on-stream period and to remove it during regeneration.

A noteworthy quality of the product is the high isopentane content of the pentane fraction of the two-pass base. The isopentane is present in this cut at a concentration of almost 95 per cent. This C_5 cut is equal to most alkylate and better than some in its 1-C octane number.

Log of Recent Operations

The unit was put on stream on August 26, 1943, after having been built at a cost of about $3,000,000. Up to December 15 the unit had been on stream for over 100 days without a shutdown. At end of that time no shutdowns were scheduled and it was expected that the unit would undoubtedly run for a period of 150 days or longer before a general cleaning of heat-transfer surfaces, tube stills, etc., would be necessary.

Miscellaneous Plant Data

The carbon deposit burned in the regeneration cycle varies from 4,000 to 6,000 lb. per hour giving an average steam production of 40,000 to 60,000 lb. per hour at a pressure of 450 lb. per sq. in. at 600° F.

To burn this amount of deposit within the cases and at the same time to maintain the temperature within satisfactory limits during the oil part

Left: Products-flow meters on the catalyst-treating unit. Right: Controls behind panel board in the control room of the Houdry unit

Left: Compact charge pumps which deliver feed to catalytic unit. Right: Close-up of bank of 30 burners on catalytic unit heater

of the cycle as well as to keep temperatures low during regeneration is, of course, one of the great engineering achievements of the Houdry process. The cases at 15 Plant embody all recent improvements and refinements in this regard. The very excellent operation of the unit both as to quality of products and as to mechanical performance is thought to be due in part to these improvements.

The steam is produced by exchanging a part of the cooling medium stream in a boiler.

Relation of 15 Plant Houdry Unit With Other Houdry Operations in the Refinery

To produce maximum quantities of 100-octane aviation gasoline all the Houdry units at Marcus Hook have been diverted from high-quality motor-gasoline production to aviation gasoline. The remaining units, with a capacity of about 50,000 bbl. per stream-day of charge contribute both to alkylate feed, as explained in another section, and to the production of first-pass base stock for charge to this unit. In producing both these necessary materials the other units operate on varying charge stocks. One unit, for example, has as its charge a very heavy cut of crude (less than 40 per cent bottoms). Other charging streams are of varying lighter-boiling types, up to and including naphtha of about 500° F. end point.

The presence of gasolines from the units of higher boiling charge in the gasoline fed to 15 Plant makes the high quality of the 15 Plant base stock even more remarkable. The whole operation of the refinery is thus idealized by the fine operation of this one unit, giving as products extremely high-quality base stock and, at the same time, large amounts of butylenes and isobutane for blending-agent manufacture.

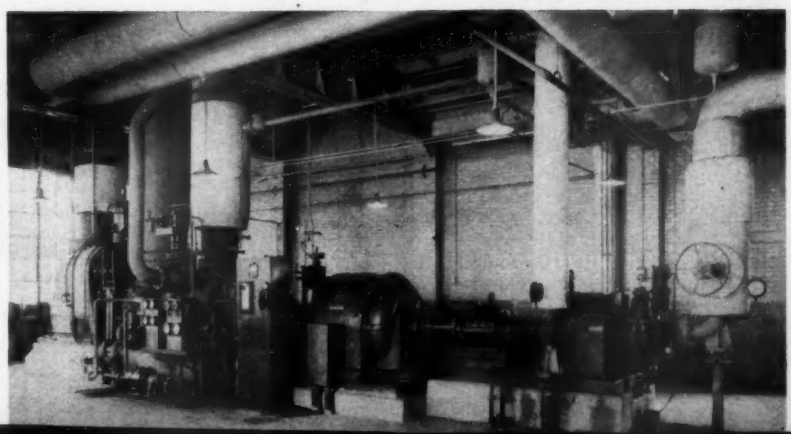
TABLE 1—NO. 15 HOUDRY UNIT. TREATING LIGHT CATALYTIC GASOLINE

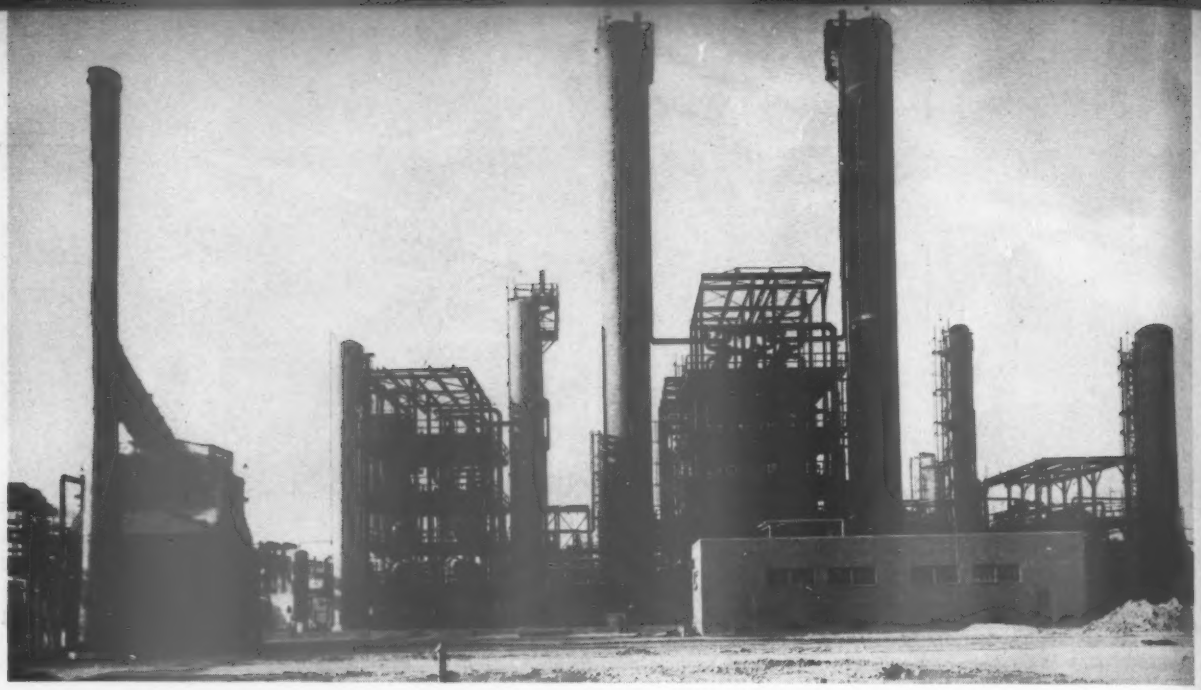
	Charge	2-pass base 71%	Naphtha 10.5%	Bottoms 4.5%	Gas %	wt. chg.
Gravity	60.4	66.0	35.7	17.2	H_2	0.1
Initial	100	100	305	359	C_1	.40
5	119	116	313	379	C_2	.11
10	130	122	317	381	C_2	.21
50	211	173	334	450	C_3	.48
90	310	276	350	610	C_3	1.56
95	328	291	360	710	Iso C_4	4.33
End point	358	317	390	760+	Iso C_4	.00
Recovery	98	98	98	98	N C_4	1.75
Color	16	30	29	T.D.	N C_4	.32
Reid vapor pressure, lb.	...	8.5	...	...		
Acid heat (deg.)	75	9.0	6.0	...	Total	9.17
AFD1C + 4 cc.	89.5	99.0	..	...		
Olefins	24	2	1	...		
Aromatics, per cent	17	21	72	...		
Pod. analysis:						
C_4	1.5	0.0	...	...		
Iso C_5	16.0	30.0	...	...		
N C_5	6.0	2.1	...	...		

TABLE 2—NO. 15-1 PLANT TREATING C. T. NAPHTHA

Per cent F.F.	Fresh feed (C.T. nap.)	Recy. nap. C.T.C. nap.	Total chg.	C.T.C. base 56 per cent	Tower btms. 12 per cent	Gas	% wt. F.F.
Gr.	34.4	32.8	33.8	37.2	14.3	H_2	.01)
Int.	284	334	269	170	385	C_1	1.28)
5	324	338	322	215	402	C_2	.35)6.64
10	332	346	330	237	410	C_2	.86)
50	360	358	356	287	484	C_3	.47)
90	397	388	400	317	620	C_3	3.67)
95	411	396	418	325	733	Iso C_4	5.25)
EP	445	432	436	338	760+	Iso C_4	.00)7.53
Rec.	98	98	98	98	98	N C_4	1.92)
Color	T.D.	12	T.D.	30	..	N C_4	0.36)
RVP	..	..	..	1.4	..	Iso C_5	4.50)
Acid heat	40	5	32	5	..	N C_5	.47)5.32
Olefins	15	1	13	1	..	C_5	.35)
Aromatics	52	76	56	76	..		
							19.49

Electric-motor-operated valves on Houdry unit





UOP alkylation unit at 15 Plant. Control house in foreground. Tall towers in center are 150-ft. deisobutanizers

Availability of Butylenes Main Consideration In Design of HF Alkylation Unit

by Paul D. Barton

THE HF alkylation unit, constructed as a part of Sun Oil Co.'s 15 Plant, was designed by Universal Oil Products Co., Chicago. A careful preliminary study of the various sources throughout Sun's Marcus Hook refinery from which B-B charge material could be obtained, as modified by projected future producing units, indicated that there would be an excess of isobutane over the theoretical requirements of the alkylation process. That is, the limiting factor governing the capacity of the alkylation unit would be the availability of olefins. At the time the plant was designed, main consideration was given to the availability of butylenes and no provision was made in plans for the segregation of amylenes or for the subsequent depentanization of the alkylate should amylenes be added to the alkylation-plant feed material.

A careful study of the volatility requirements for motor gasoline together with the relatively large proportion of the total available butane-butene fractions which would be removed from consideration by conversion to alkylate, lead us to recommend the installation of a fairly large pressure-storage capacity. An auxiliary-storage plant consisting of seven 40,000-bbl. spheroids designed for 20 p.s.i.g. with its own compression-recovery system was installed. These facilities were made available for use approximately 6 months prior to the completion of the alkylation unit with the result that much potential alkylate production was saved for the aviation-gasoline program, in addition to the 568,-185 bbl. of B-B feed stock made available to other operating alkylation plants and shipped to them in tank cars. This was made possible by the early completion of a large light-gasoline fractionating unit which was placed in operation in February 1942.

The storage plant is arranged to take care of variable quantities of B-B alkylation plant feed, excess isobutane, and residual normal butane, anticipating the variable production and utilization from winter to summer. The necessity for accumulating normal butane for gasoline volatility requirements during the warm months for utilization during the cold months is necessitated by the relatively small proportion of normal butane to the combined butylenes and isobutane because of the inherent characteristics of the light fractions produced by the Houdry catalytic cracking process.

Because of the prefractionation of

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Barton graduated from University of Oklahoma in 1919 and obtained a B.S. degree from California Institute of Technology in 1920.

He has the distinction of having served as the first president of the California Natural Gasoline Association. Barton is a member of the A.G.A.C. alkylation subcommittee.

Flow diagram of UOP hydrofluoric acid alkylation unit

the streams from which the composite B-B cut is obtained, the H_2S and mercaptan content of the feed stock is relatively low. For this reason, the only pretreatment necessary is considered to be a single-stage caustic wash using 15° Baume NaOH circulated counter current over a vertical Raschig ring packed column. This column is 5 ft. 6 in. in diameter, 30 ft. high with 21 ft. of 1½-in. carbon rings. The caustic is circulated at a rate of 45 g.p.m. by a pump taking suction from a settling tank carried liquid full, the treated B-B flowing by displacement from the top of this tank through a drying unit to the contactor charge storage drum. The caustic is circulated until nearly spent after which it is pumped to caustic disposal and a fresh charge introduced.

The drying unit consists of three vertical chambers 3 ft. 6 in. in diameter by 12 ft. high, each containing a 10-ft. bed of activated bauxite or similar granular absorbent material. Two of these units are used in series while the third is being regenerated. The regeneration is accomplished by draining the liquid and passing superheated butane vapor, utilizing a portion of treated B-B, through a condenser to a water-separating tank. This is a closed system and no loss of feed stock occurs because of this operation.

Reaction Section

The unit is provided with two complete sets of reaction equipment either one or both of which may be used at will.

One set consists of three Stratco, type 50, water-cooled contactors arranged for series flow of isobutane recycle and acid, with parallel flow of fresh B-B feed. The effluent of the third contactor in the series discharges to an acid settler from which the acid is recirculated to the contactors, the hydrocarbon phase containing unreacted isobutane, normal butane and alkylate is displaced to an operating storage tank.

The other set consists of three similar contactors arranged for parallel operation on acid, isobutane recycle and fresh feed. The combined effluent from all three of the parallel contactors discharges to its own acid settler operated in the same manner as the settler on the series side, the hydrocarbons being discharged to the same operating storage tank.

HF Stripper Operation

The hydrocarbons accumulated in the storage tank referred to in the last paragraph contains a small amount of dissolved HF in addition to organic fluorides. Some of these combined fluorides are quite unstable and are broken down by heat to free HF and hydrocarbon. The dissolved HF plus the acid released by the decomposition of the unstable organic fluorides is removed in a vertical distillation column which we call the HF stripper by distillation, being carried overhead with the vaporized portion of the feed to a condenser and accumulator from which the separated acid is returned to the acid settlers.

The HF stripper is an 8-ft. diameter, 20-plate column, operated at approximately 200 p.s.i.g. The feed is introduced on the top tray and no reflux is used, the overhead hydrocarbons which are condensed being returned to the charge storage tank. The bottom of the column is heated by means of a once-through type reboiler to approximately 200° F.

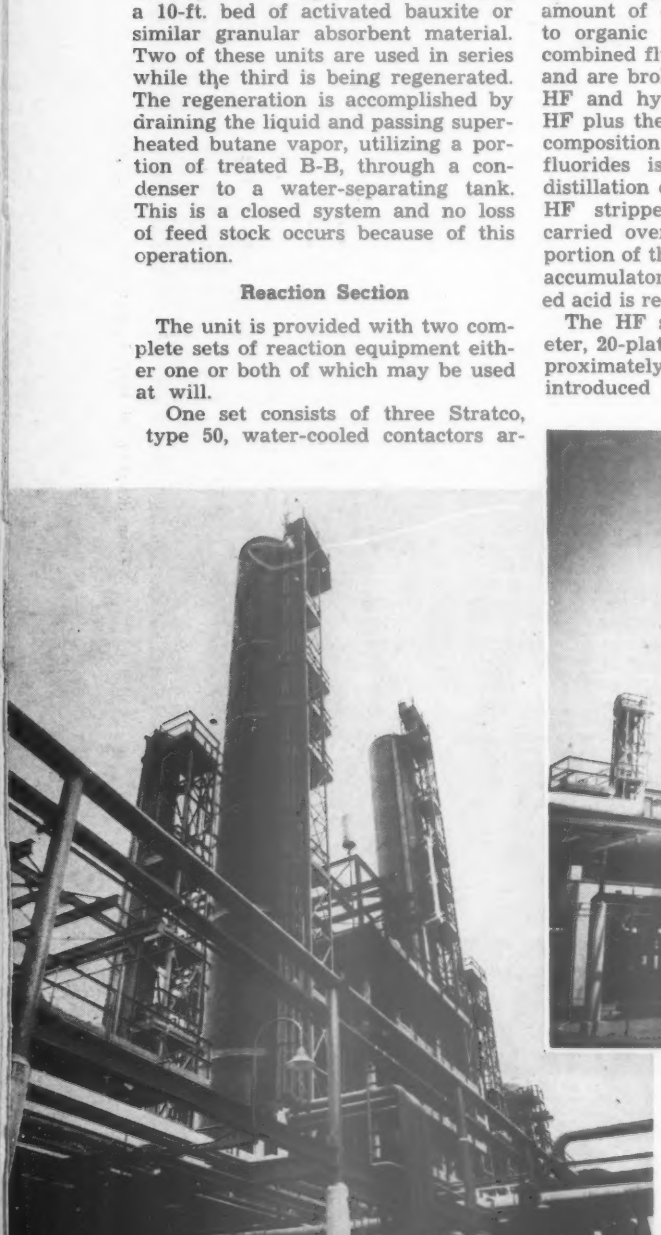
Hydrocarbon Defluorination

Under normal operation, the hydrocarbon stream leaving the bottom of the HF stripper tests free from HF although a certain amount of combined fluorides remain.

Two bauxite defluorinators were installed to operate in series or parallel on the hot liquid stream leaving the bottom of the HF stripper column. These bauxite treaters consisted of vertical columns 8 ft. in diameter, approximately 40 ft. high containing 33 ft. of granular bauxite. These towers are designed to be operated at the liquid pressure existing at the HF stripper less the normal pressure drop. Approximately 90 per cent of total defluorination is normally obtained by this method and a given tower remains effective until it has absorbed approximately 20 per cent of the weight of its bauxite of fluorides.

Operating difficulties are introduced by the release of SiF_4 resulting from the reaction of HF (probably from the decomposition of unstable fluorides) upon the silica content of bauxite. This compound is carried with the hydrocarbon stream into the isobutane fractionating system, where it is deposited as a white siliceous solid.

Experimentation with catalytic defluorination has been in progress for



Left: Fractionation section of alkylation unit. Above: Alkylation unit showing control house in foreground

several months and we have decided to supplement the bauxite defluorination with a combined HF stripper and catalytic defluorinator.

One benefit from the use of catalytic defluorination would be through the reduced consumption of bauxite which is a critical material as well as the partial elimination of an annoying disposal problem involved in the dumping of spent bauxite.

Isobutane Fractionation

The defluorinated hydrocarbon stream is charged continuously after defluorination to two deisobutanizer columns operated in parallel. These two columns are identical, being 11 ft. in diameter and approximately 150 ft. in over-all height. Each has 50 bubble plates spaced on 24-in. centers. Each tower has its own kettle-type steam-heated reboiler, but the overhead vapors from each is combined into a common set of reflux condensers with a single accumulator, the isobutane product passing to final condensers and accumulator. These towers are operated at 100 p.s.i.g. and are designed to produce an isobutane fraction for recirculation to the reaction section of 90 per cent purity.

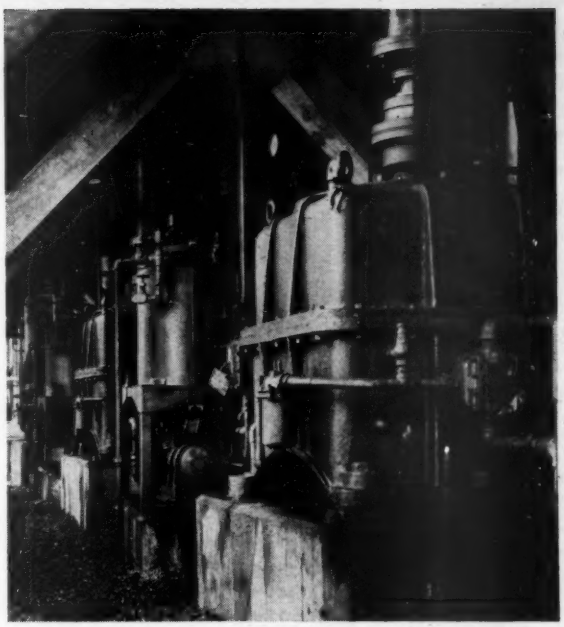
Propane Removal

Because of the effectiveness of the prefractionation of the B-B feed material produced from the two main sources supplying the alkylation unit, it was thought unnecessary to depropanize the entire alkylation-plant hydrocarbon stream as is done in some cases. However, any propane inclusion whatever would tend to remain in the system and accumulate in the isobutane recycle stream. To eliminate this buildup of propane a depropanizer was installed to operate upon a portion of the isobutane recycle stream to keep the propane content from building up beyond a certain definite maximum. For design purposes, this maximum was set at 4.4 per cent; and it is only necessary to depropanize 20 to 25 per cent of the total isobutane recycle in order to hold the propane at this figure.

The depropanizer consists of a 4-ft. diameter column containing 30 plates spaced 18 in. apart. It is equipped with a once-through reboiler and an overhead condenser and accumulator. The propane product is removed as it builds up in the reflux accumulator as an excess reflux quantity being cooled as a liquid and piped to storage. This propane product is free from unsaturates and may be segregated for a special use if desired.

Alkylate Debutanizer

The bottoms from the isobutane fractionating columns described above now contain only alkylate and residual normal butane with a small amount of isobutane and traces of organic fluorides. This mixture is charged continuously to an alkylate debutanizing column operated for complete removal of normal butane as an overhead product, the alkylate remaining in the bottoms. This column is 7 ft. in diameter containing 30 plates spaced 18 in. apart, and is equipped with a gas-fired circulating-type reboiler. This column operates at approximately 90 p.s.i.g. and requires a bottom temperature of approximately 400° F. This temperature could have been obtained by the use of 450-lb. steam but for economy we decided to use the gas-fired type, heat duty of this unit being fairly large.



Main drive on one of optional sets of three reactors of alkylation unit

The high temperature at the bottom of the alkylate debutanizer can result in the further decomposition of traces of combined fluorides, so as an added precaution, these bottoms are further treated in a secondary adsorption step similar to the one described above, but on a much smaller scale. The secondary bauxite towers are only 3 ft. 6 in. in diameter and contain only ⅛ of the amount of bauxite used in the primary towers.

Alkylate Rerun Operation

The debutanized alkylate, after the secondary defluorination operation, is charged continuously to a rerun column for the purpose of obtaining an aviation-grade alkylate cut as an overhead product. This column is 7 ft. in diameter and contains 20 plates spaced 24 in. apart. It is designed to operate at a few pounds above atmospheric and the condensing system is piped to a vent tank with no intermediate back-pressure control, this vent tank being open to the atmosphere. The bottoms product from the rerunning operation is of a quality which can be blended successfully with motor gasoline. In our own experience, however, the amount of this material is very small and is used within the unit as a gland seal oil at the stuffing boxes of the various centrifugal pumps. Leakage of this material into the circulating system finally returns to the rerun column, external leakage being recovered with slop oil in the water separators.

Anhydrous hydrofluoric acid is used in the plant as a catalyst. As the acid is recirculated in the reaction zone of the plant, impurities consisting of dissolved hydrocarbons and high-boiling polymers formed in side reactions gradually build up in the acid phase. Also, water not completely removed from the B-B feed, and that picked up from the bauxite, also builds up in the acid phase.

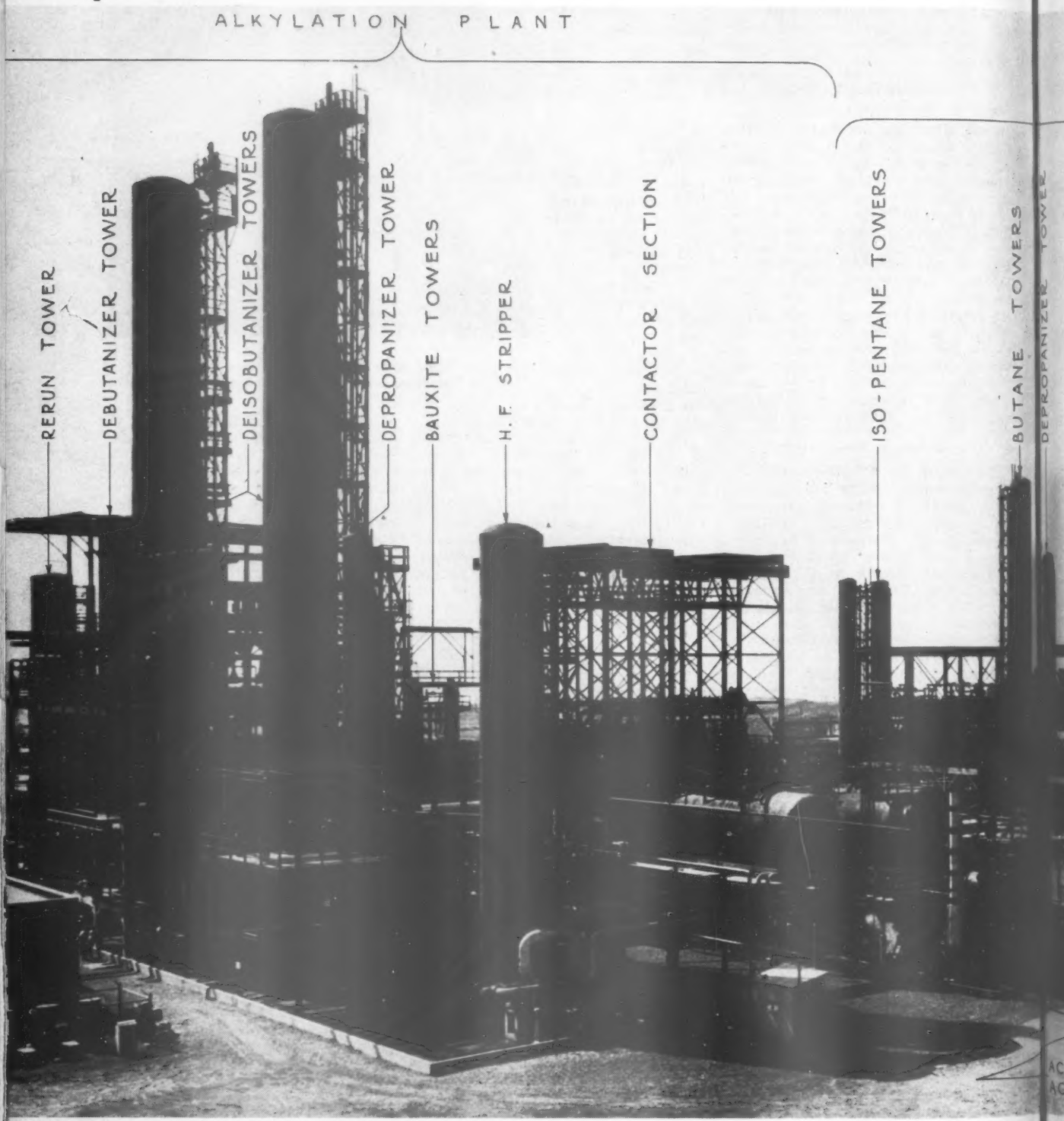
The regeneration of the acid is accomplished by distillation in two steps: The acid and water being removed from the polymers in the first step, the acid from the water in the second. Modification of the regeneration section, as originally designed, is in progress, but the essential features of the process are unchanged.

Safety Features

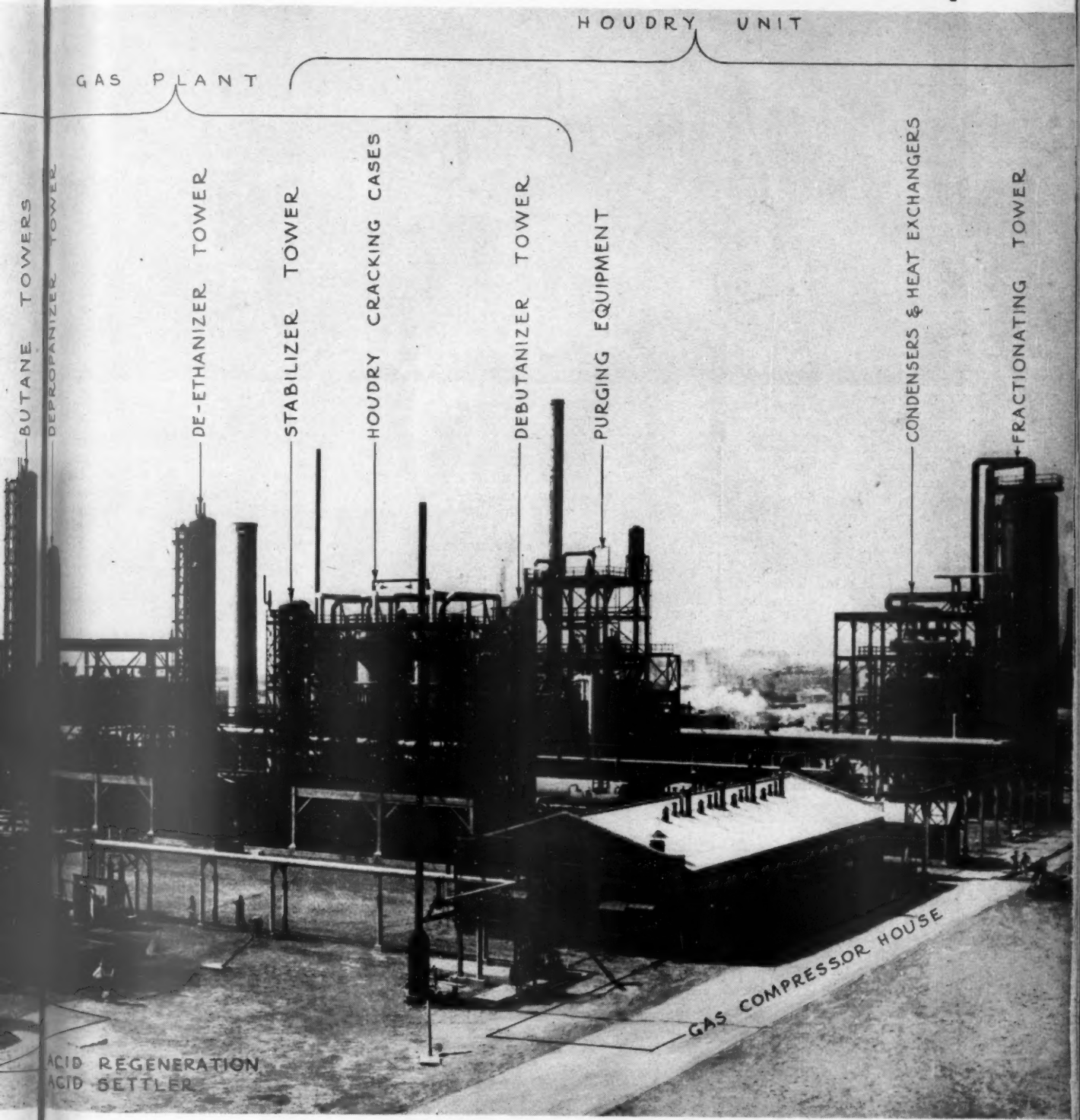
The inventory supply of anhydrous hydrofluoric acid is stored at an area approximately 500 ft. from the main operating unit. Also in this area is the safety blowdown tank which is designed to receive the entire mixed acid and hydrocarbon in the reaction section of the plant in an emergency. The relief to the blowdown section is either automatic or manual at the will of the operators, hydraulically operated drop-out valves being located at low points of the six contactors and two settlers. These valves open automatically with an increase in pressure to a set maximum. In an emergency, the hydraulic pressure to operate these valves can be supplied by a small air-operated reciprocating pump outside of the acid zone.

Also located in the storage and blowdown area is the caustic relief scrubber which is designed to absorb hydrofluoric acid vapor in a circulating caustic solution.

PANORAMIC VIEW OF SUN OIL'S 15 PLANT

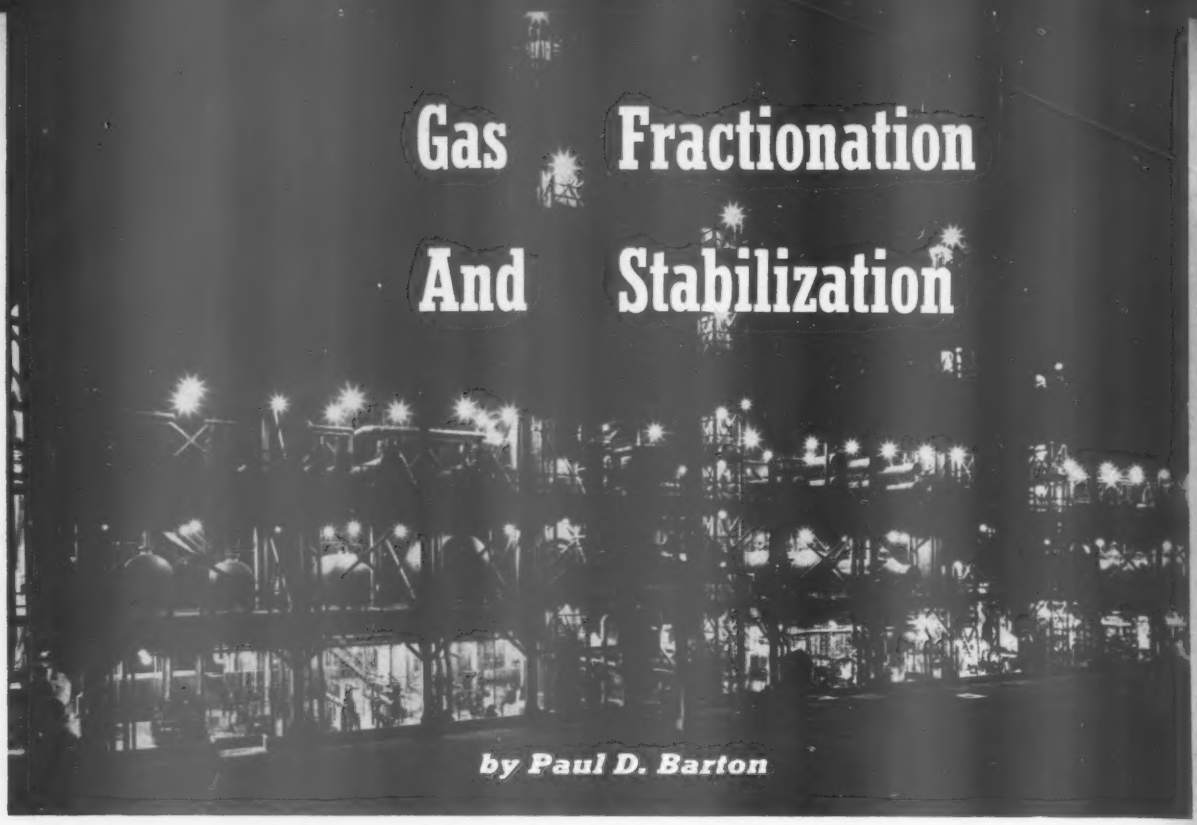


IDENTIFYING THE VARIOUS COMPONENT UNITS



Gas Fractionation And Stabilization

by Paul D. Barton



Night view of gas fractionation and stabilizer unit of 15 Plant

THE problem of recovering light gasoline and other desired hydrocarbon fractions was closely associated with the requirements imposed by the other two main operating units of 15 Plant, namely, the Houdry catalytic plant and the HF alkylation unit. The writer was assisted in the work of processing by one of E. B. Badger & Sons Co. engineers, Dr. C. C. Peavey.* A great deal of preliminary work had been done by Sun Oil Co. in determining the type of gases to be handled, the magnitude of the variations and gas composition, and similar factors which radically influence the economics of recovery plant design. Preliminary calculations were made to determine reasonable recovery factors possible with several types of operations and sets of operating conditions, and a study of the results led to the conclusion that the most favorable results could be obtained on this particular type of gas with a simple direct fractionation of the gas at relatively high pressure.

The main source of wet gas to be handled in this unit was a 20,000-bbl. Houdry catalytic gas-oil unit, which was the same that supplied the raw base stock to be handled in the 15 Plant Houdry catalytic-treating unit for the production of 100-octane, two-pass catalytic base stock. This producing source is approximately a mile from the site of 15 Plant, and since both wet gas and unstable gasoline were to be handled in the proposed new gas recovery unit, it was decided to introduce an equilibrium contact operation at the existing plant. This was done in order to obtain the lowest possible wet-gas volume for transmission to the new site without making any major changes in the existing unit as to its operating conditions of temperature and pressure.

In order to visualize the effect of the equilibrium contact operation upon the relative volumes and compositions of the two streams (wet gas and unstable gasoline) from this producing unit, see accompanying table:

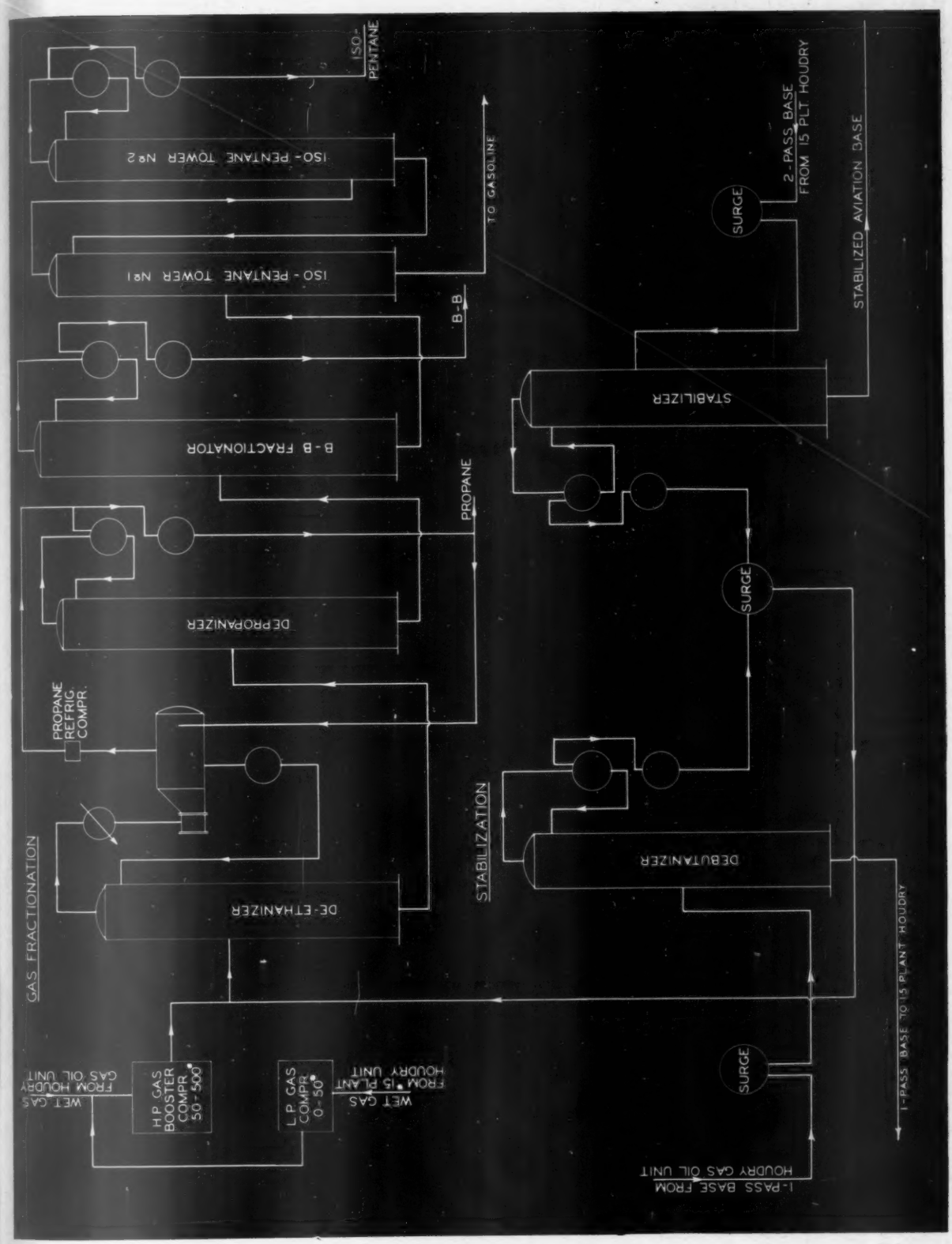
Constituent	Orig. sep. pressure — Gas Mol %	Orig. sep. pressure — Gasoline Mol %	After contact at 50 p.s.i.g. — Gas Mol %	After contact at 50 p.s.i.g. — Gasoline Mol %
Acid gases)	5.5	...	9.8	...
Hydrogen)				
Methane	11.3	0.1	19.6	0.4
Ethane-ene	6.3	0.1	9.8	0.9
Propane-ene	22.3	1.6	26.8	8.4
Isobutane	20.4	3.7	17.2	13.1
Butylenes	6.6	1.2	5.2	4.5
nButane	5.1	1.2	3.7	3.7
Isopentane	10.0	5.8	4.7	10.7
nPentane	2.1	1.6	0.9	2.6
Hexane	5.9	12.4	1.4	12.0
Heptane	2.7	15.8	0.5	11.1
Octane	1.0	17.1	0.2	10.3
Nonane+	0.8	39.4	0.2	22.3
Lb./hr.	67,517	79,470	29,738	117,249
Mols./hr.	1304.0	.....	725.1	.....

After contacting, the reduced volume of gas is transmitted at 50 lb. pressure directly to the compression unit of 15 Gas Plant where it is further compressed in two-stage gas-engine-driven compressors without intercooling to a final pressure of 450 to 500 p.s.i.g. The relatively small amount of gas produced in the 15 Plant catalytic treater is compressed from atmospheric pressure to 50 lb. and joins the main stream of gas described above, the combined stream from the high-pressure units, discharging directly to the gas fractionating tower which we designate as the deethanizer.

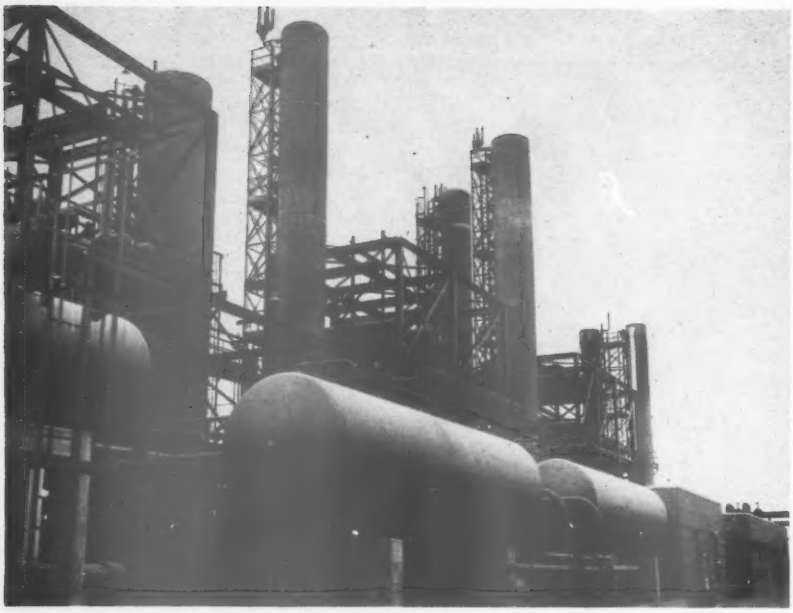
Gas Fractionation

The deethanizer is a conventional plate column 7 ft. in diameter with 30 bubble plates spaced on 2-ft. centers and operated at 450 p.s.i.g. This column is refluxed with a refrigerated liquid condensate produced in equilibrium with the residue gas in an indirect refrigerated condenser operated at from 45° to 50° F. The refrigeration is obtained by the expansion of liquid propane drawn from the propane produced in the plant, the propane vapor being recovered by auxiliary steam-driven compres-

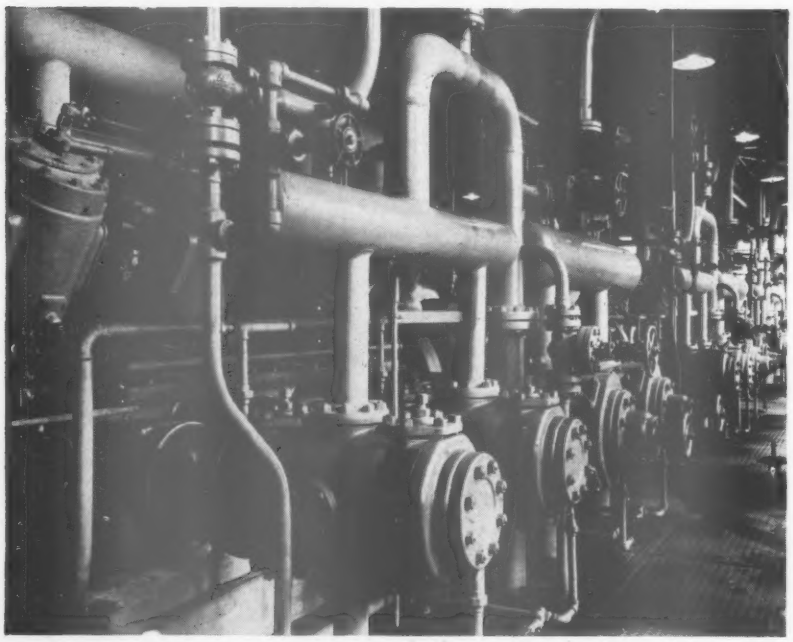
*Present address: Socony-Vacuum Oil Co., Augusta, Kans.



Flow diagram of gas fractionation and stabilization unit



View of gas plant showing feed tanks, control house and refrigeration unit in foreground with fractionating towers in the rear



Compression cylinders on gas-engine-driven compressors

sors which return the recovered propane to the main source of supply.

The normal overhead temperature of the deethanizer is 125° F. which makes possible a recovery of over 98 per cent of the isobutane and over 60 per cent of the propane fed to the unit. We hesitated to use refrigeration direct on the top of the column because of the possibility of trouble from the formation of gas hydrates. In operation we have demonstrated that we can operate the reflux condensing system at 50° F. without difficulty from this source, but that at the design temperature of 45° F. difficulty from this source was quite noticeable. The formation of gas hydrates at the lower temperature is evidenced first by an irregularity in the operation of the reflux pump followed by a complete loss of suction owing to the buildup of solids in the bottom of the accumulator. The condition seems to be quite critical and by raising the temperature a few degrees the solid formation disappears.

Propane Column

Bottoms from the deethanizer are found to be essentially free from ethane and lighter fractions, and contain the recovered portion of the propane and essentially all of the heavier constituents fed to the deethanizer. This bottom product constitutes the feed for the next column in series which is the depropanizer.

The depropanizer column is a 40-plate bubble column 6 ft. in diameter designed for operation at 250 p.s.i.g. The operation of this column is that of a conventional liquid fractionating column equipped with a kettle-type reboiler, propane reflux condensers and accumulator operated with a vapor bypass around the condensers with a liquid level control valve in the bypass. The pressure of the column is established by means of a back-pressure controller located in the vapor line leaving the reflux accumulator. The final product, condensers, and accumulator are operated at equilibrium conditions. This arrangement prevents variations in condenser-water temperature from being reflected in the operation of the fractionating column itself. This column operates very smoothly and is designed to produce a commercial propane cut as the overhead product with sufficient depropanization of the bottoms so that the subsequent butane product will contain less than 1 mol. per cent of propane.

Butane Column

The butane column is 9 ft. in diameter and has 40 bubble trays spaced at intervals of 24 in. Its function is to produce a single cut containing all of the C_4 fractions entering the unit. This is one of the main sources of B-B charge material for the HF alkylation unit. A special requirement of this column is a sharp fractionation between normal butane in the overhead and isopentane in the bottoms. At times, there is an excess of isopentane above the vapor pressure requirements of the two-pass catalytic base stock and it is desired to recover this isopentane as supplementary blending agent.

The operation of the butane column is quite similar to that described for the propane column above, in that it has a conventional kettle-type reboiler and separate reflux and product condensers and accumulators. It is worthy of note that the reboiler is designed to operate with low pressure steam using exhaust steam at 40 p.s.i.g. pressure derived from the refrigeration-propane compressors mentioned above. This reboiler has a normal duty of 19,900,000 B.t.u. per hour. The design incorporates the use of U-tubes in a shallow, rectangular arrangement which gives a very large vapor disengagement area and trans-

fer rates on test have been observed to be as high as 230 B.t.u. per square foot per degree per hour.

Isopentane Fractionation

The bottoms from the butane column, substantially butane free, constitute the feed for the isopentane columns. Essentially, the isopentane fractionation is conducted in a single column which has been cut in two for structural reasons, the two parts being operated in series with the liquid from the bottom of the second half being returned to the top of the first half by means of a pump, the vapor from the first section being fed to the base of the second. Each section is 6 ft. in diameter by 80 ft. high, containing 30 bubble plates spaced at 24-in. intervals. This column would have been entirely too high for stability unless the shell thicknesses were greatly increased. The necessity for saving steel prompted the construction in two sections. Other than the division of this column into two sections, it is designed to operate as a conventional liquid fractionator having separate reflux and product condensers similar to the propane and butane columns described above. The column is designed for producing an isopentane fraction of approximately 98 per cent purity. However, in actual operation the method depends somewhat upon the magnitude of excess isopentane available. It has been found desirable to return the bottoms from the isopentane fractionating unit to the Houdry catalytic treater charge and when the excess is small the entire C_5 cut is so returned.

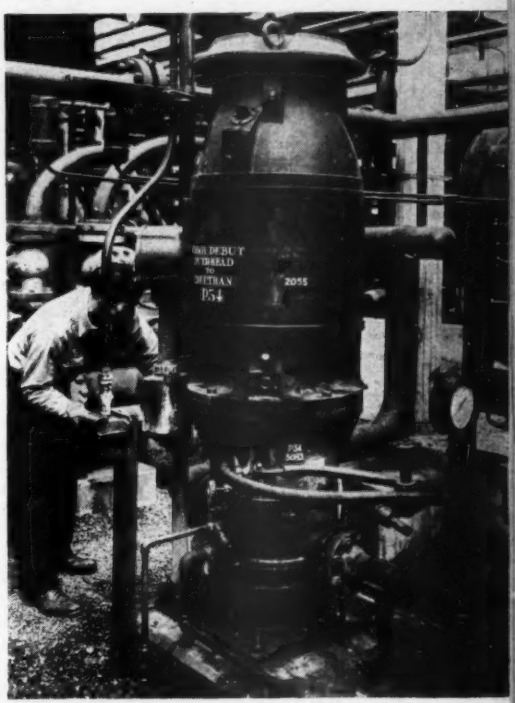
In addition to the facilities for fractionating the gas described above, the unit is also required to fractionate certain liquid streams independently. By reference to the preceding section, it will be seen that the main source of one-pass catalytic base stock is the material produced along with the wet gas in an existing Houdry catalytic gas-oil cracking unit. The accompanying table gives the composition of this gasoline stream after the equilibrium contact at 50 p.s.i.g. with the gas produced in the same unit. It has been found desirable to completely debutanize the charge to the second-pass catalytic treating operation for the production of high-quality aviation gasoline base stock. Facilities were provided in 15 Gas Plant to perform this operation. Likewise, the second-pass catalytic treating step radically changes the composition as well as the quality, and it is necessary to restabilize this gasoline after this second-pass treatment. This operation is also conducted in 15 Gas Plant.

Treater Feed Debutanizer

Because of the light fractions present in the gasoline, resulting from the equilibrium condensation at 50 p.s.i.g. in the presence of the wet gas, it was decided to operate the debutanizer at a pressure high enough to obtain the major portion of the overhead product as a liquid, thus minimizing the recompression of large volumes of vapors, but low enough to make possible the operation of the reboiler with 450 p.s.i.g. steam. An operating pressure of 185 p.s.i.g. was selected. The unit is provided with a feed tank of a size selected to smooth out the production surges from the source a mile away. A similar surge tank was provided for the overhead product to facilitate its subsequent fractionation. The column itself is 6 ft. in diameter and has 30 plates spaced at 18-in. intervals. In operation a very sharp cut is being obtained between normal butane in the overhead and isopentane in the bottoms.

The second-pass catalytic treated base stock returns to 15 Gas Plant entering a charge surge tank. An operating pressure of 175 p.s.i.g. was selected for this stabilizer, the reasoning being similar to that described in the selection of the operating pressure for the treater-feed debutanizer. The aviation gasoline stabilizer is an 8-ft. column containing 30 plates spaced at 18-in. intervals. The greater diameter is accounted for by the fact that a higher reflux ratio is required for the fractionation and, also, at times the Houdry catalytic treating unit runs additional amounts of stabilized base stock from another source. The overhead from this column enters the same accumulator tank fed by the treater-feed debutanizer. The combined light liquid fractions are charged to the deethanizer along with the compressed gas feed described earlier.

Both of these liquid fractionating columns are equipped with conventional feed-bottoms heat exchangers, bottoms coolers, kettle-type reboilers, and separate reflux and final product condensers.



Charge pump which delivers debutanizer overhead to deethanizer

Gas-engine-driven compressors which compress charge to gas plant to 450-500 p.s.i.

Ample Laboratory Facilities and Personnel Assure Efficient Control of Processes

by J. Bennett Hill

J. Bennett Hill, manager of the Development Division, Sun Oil Co., has been with Sun for 9 years, following 10 years with Atlantic Refining Co. as chief chemist. Previous to his association with Atlantic, he was laboratory manager for the Barrett Co. at Frankford, Pa.

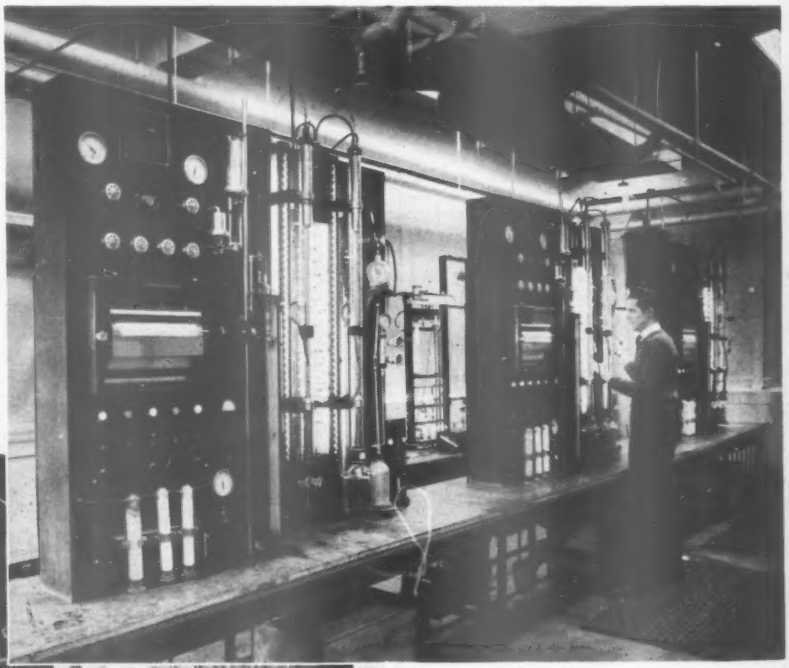
Dr. Hill graduated from the University of Pennsylvania in 1913 with a B.S. degree. He received his Ph.D. there in 1916 and the degree of Ch.E. in 1937.

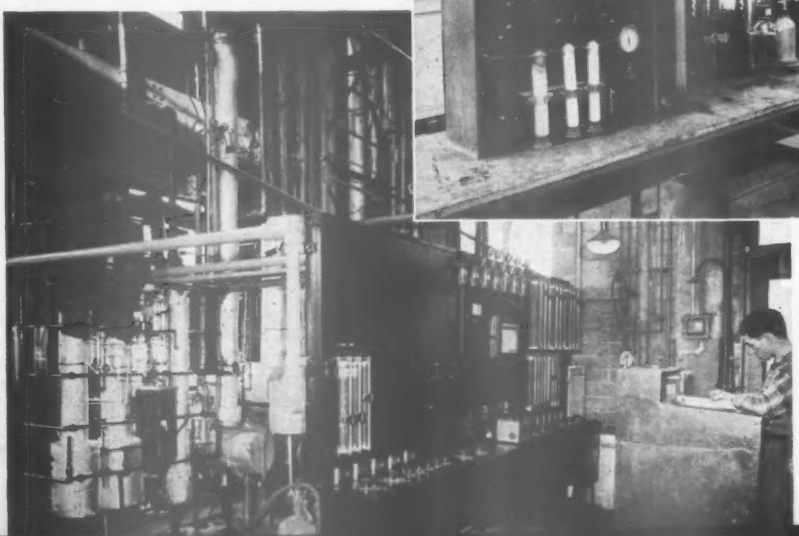
Dr. Hill is a member of the Hydrocarbon Research Committee, chairman of the Advisory Committee on Fundamental Research on Composition and Properties of Petroleum, and a member of the Program and Testing Methods and Specifications Committees of the Division of Refining, A.P.I. He is also a member of the council, American Chemical Society, a member of the Institute of Chemical Engineers, and a member of the Committees D-2 (Petroleum) and D-16 (Aromatic Hydrocarbons), A.S.T.M.

LABORATORY control of a modern unit like 15 Plant is quite a different proposition from the control of a plant of not so very many years ago. With the complexity of the flow sheet with all of its varied streams and interconnections, knowledge of what the units are doing is no longer simply a matter of reading the tank gages and taking gravities and distillations of the tank contents but becomes a matter of a constant evaluation of the streams at intermediate points. Then, too, the volume throughput of 15 Plant is so great that little errors run into big losses of barrels production and a degree of accuracy is therefore required which would have been ridiculous some time ago. It has been said that it takes more chemists and engineers to run a modern plant than it does operators and that statement is not far from the truth in the case of 15 Plant.

Extension of the laboratory testing facilities in order to take care of this new plant was of course necessary. For the sake of prompt results it was decided to provide the routine testing facilities and many of the new tests special to these operations in a new building within the 15 Plant limits rather than to combine them with the central refinery laboratory. On account of the great importance of Podbielniak analyses in the operations of this plant the existing "Pod" laboratory was moved completely from its old location at the older cracking plants to the new building and was approximately trebled in staff and facilities. This new laboratory building provides 2,200 sq. ft. of actual work space exclusive of offices and contains a laboratory staff of about 50 chemists, technicians and testers. About three-quarters of its personnel are women.

For the more elaborate tests including the engine tests the facilities at





Right: Three Podbielniak columns in one section of the enlarged "Pod" lab, an important unit in the operations of 15 Plant.

Below: Control board and base of the pilot plant in the semiworks laboratory

the existing locations were increased to handle the extra work of this plant.

The Houdry unit in the plant is subject to the usual primary laboratory control which comprises sampling and testing the feed stream, the fractionating tower overhead, the tower side stream and bottoms and the debutanized product. A satisfactory control in this plant can be maintained by taking the samples not oftener than once per shift, the principal checks being gravity, distillation, color and vapor pressure. At least once a day octane tests are run on the product. In certain types of operation for the production of especially high-octane materials the octanes are run once a shift as is also the hydrocarbon composition analysis for aromatics and olefins. The debutanization of the feed and product is controlled by Pod analyses in order to minimize the amount of butanes and lighter in the feed and to insure complete isopentane recovery in the aviation gasoline without the inclusion of butane.

Two-Phase Sampling

Determination of yield and quality from this unit is complicated by the fact that gas from the unit, containing a considerable proportion of the isopentane, goes to the gas-recovery unit along with gas from various other sources. It has been our experience that separate evaluations of this gas stream for incorporation into a material balance on the Houdry unit for yield and quality is extremely unsatisfactory and that the best scheme for obtaining reliable information is to make frequent periodic surveys in which the entire stream from the cases containing both the gas and liquid is sampled and evaluated. These evaluations do not consist of a few simple tests but each one is a project of a kind that was once considered a research investigation. This work is carried out by a "survey" group of chemical engineers and assistants, assigned to this unit. The general procedure is to sample the case product in the vapor phase and to condense it under carefully controlled conditions whereby most of the pentanes remain in the liquid portion. The ratio of the liquid to gas is determined carefully and Pod analyses are made upon representative portions of each. In this manner both volume and weight per cent of hydrocarbons lighter than hexanes are determined. The liquid portion of the product is debutanized accurately by a fractionating column of about 35 theoretical plates. The column is arranged so that it screws directly into the top bung of the drum in which the sample is taken. The drum is stood on an electric hot plate for heat. The outfit is run at atmospheric pressure and the reflux is obtained by circulation of refrigerated alcohol through a condenser at the top of the column. The debutanized product is then subjected to a precise distillation in a 5-gal. fractionating still, taking overhead a standard arbitrary aviation cut with a 90 per cent point of 275° F. The standard boiling range is used so that direct comparisons can be made. The charge to the unit is also stabilized and distilled in similar equipment making the same boiling-range aviation gasoline as obtained from the product. Both gasolines are tested completely in respect to physical tests including hydrocarbon composition, octane numbers and octane blending values. A comparison of Pod analyses, yield of gasoline, and properties of a sample from both the charge and the product enables evaluation of the effect and activity of the catalyst.

Left: Columns three stories tall are part of the pilot plant in the semiworks laboratory. Girls comprise three-quarters of lab personnel. One is shown here operating a Pod column

Condensed Yield Surveys

By a shortened procedure condensed yields are obtained at least several times each week. In these condensed yield surveys a similar sampling procedure is used as described above. However, no Pod analyses are obtained on the liquid and only a short Pod, to give the split between pentane, and butane and lighter, is obtained. A less-efficient still run is made and yields are calculated, allowing for the pentanes determined by the Pod analysis on the wet gas. The main purpose of this procedure is to obtain a reasonably quick yield value under a given set of operating conditions. No attempt is made to determine the individual hydrocarbons or the over-all effect on hydrocarbon composition.

The survey group also collects, records and tabulates the operating data for the plant and all of these reports are studied for possibilities of improving yields and quality by the development and engineering divisions as well as by the refinery organization. The data are kept plotted and the trend of the curves will show the rate of deterioration of the catalyst and indicate when a change of catalyst is desirable.

The gas-recovery unit streams are followed by means of the usual tests but, on account of the importance of isobutane, butylene, and isopentane in this plant, particular emphasis must be put on Pod analyses. The usual light product tests are made on frequent samples and the treater feed, stabilizer, isopentane, butane, propane, and ethane towers are tested about three times a week by complete Pods so that the degree of fractionation obtained in the towers can be estimated and the proper split between the various hydrocarbon gases insured.

The alkylation unit presents many new control problems. In this plant, some of the streams are liquids, some are liquefied gases, and others are liquid hydrogen fluoride. The latter must be controlled for hydrogen fluoride acidity and for water content. The streams which have come out of contact with the hydrogen fluoride must be also controlled for

Note how neatly B-H Koldboard cuts and how easily it fits the broad curve of the spheroid. The surface of the spheroid is first given an asphalt coating. Then the Koldboard is applied and finished off with a water-proofing substance such as B-H Weatherseal.

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The distinctive feature of the Houdry process, which is in operation in the Sun Oil Co. plants at Marcus Hook, including the new $13,000,000 plant dedicated last week, is an automatic timing device, [illegible] which controls the cycles of the catalytic action which break down various charging stocks, including straight run gasoline, into the powerful fuel essential to the operation of military aircraft.

So completely does the automatic timing device control the process, that a crew of five is all the labor that is needed to operate a unit with a capacity of 1000 barrels of gasoline an hour.

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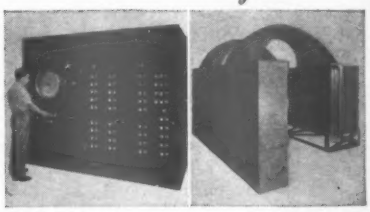

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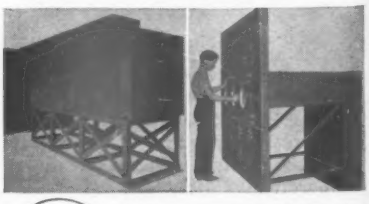

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hydrogen fluoride. The fact also that there is some slight combination of fluorine with the hydrocarbons into organic fluorides and with any silicon in the system into silicon tetrafluoride means a close check on the fluorine content of the liquid streams and on the silicon tetrafluoride content of the recirculating streams.

The ratio of isobutane to butenes in the feed to the alkylation plant is quite important and is controlled by Pod analyses both on the B-B storage in the spheroids and on the actual feed to the plant. Pod analyses also control the possible loss of isobutane in the propane product stream, the dilution of the isobutane recirculating stream with undesired hydrocarbons and the possible loss of isobutane to the normal butane stream. The aviation alkylate product is tested every 2 hours for the simpler tests and a 24-hour composite is tested completely each day. The controlling octanes for the running of the plant are the A.S.T.M. and Research, since it has been found that a good prediction of changes in the aviation octanes can be made from these simpler tests.

In addition to the above a pilot plant is operated in conjunction with the plant unit for the purpose of determining the specific behavior of various feed stock modifications, various degrees of acid purity, and desired changes in operating conditions. This pilot plant is composed of a charging system, a Turbo mixer-type contactor, acid addition system, acid stripper, and debutanizing and rerun columns. The contactor and entire acid system are enclosed in a safety hood connected to an exhaust stop, thereby minimizing hazards to the operating personnel. Auxiliary equipment consists of a feed dryer, bauxite treaters on the stripper bottoms, and rerun tower overhead. No provision has been made to provide its own isobutane recycle, nor to provide for regeneration of spent acid.

Pilot-Plant Capacity

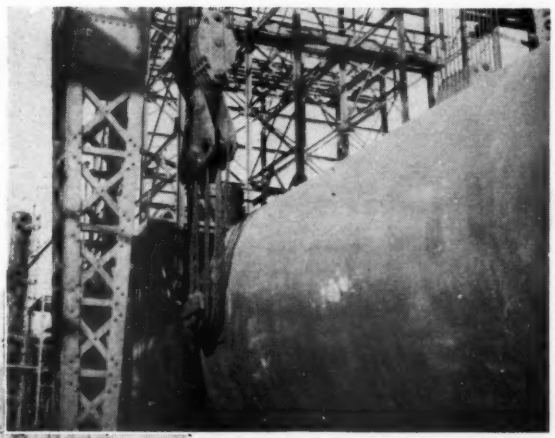
The pilot plant can produce from 4 to 20 gal. of alkylate per day. This flexibility is obtained by interchangeable contactor units. The pilot plant is situated so that it may obtain its charging stock, recycle stock, and acid direct from the commercial unit. Charging tanks and meters on various streams permit weight balances. In these the products check the feed to within about 2 per cent and reasonably accurate yield data are therefore obtained. The quality of alkylate from the pilot plant has agreed closely with that obtained from the commercial plant operating under similar conditions.

The operation of these units has shown the desirability of better methods for the quick examination of the products and intermediates at various points and studies are being made continuously toward the adaptation of some of the newer analytical techniques to the improvement of the control.

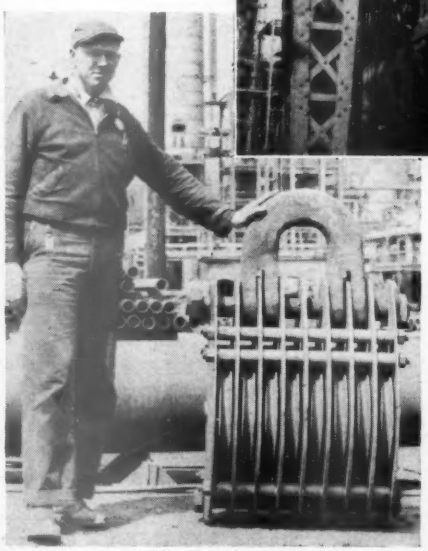
The proper control of this plant has required the cooperation of a large group of men and tribute is paid both to the guiding spirits as listed below and through them to their whole organizations for the enthusiastic effort which has made successful control of this big plant possible.

Refinery laboratory: E. M. Hughes, chief chemist; G. E. Reese, assistant chief chemist; J. B. Weller, foreman of 15 Plant laboratory; W. K. Parcells, supervisor of chemical laboratory.

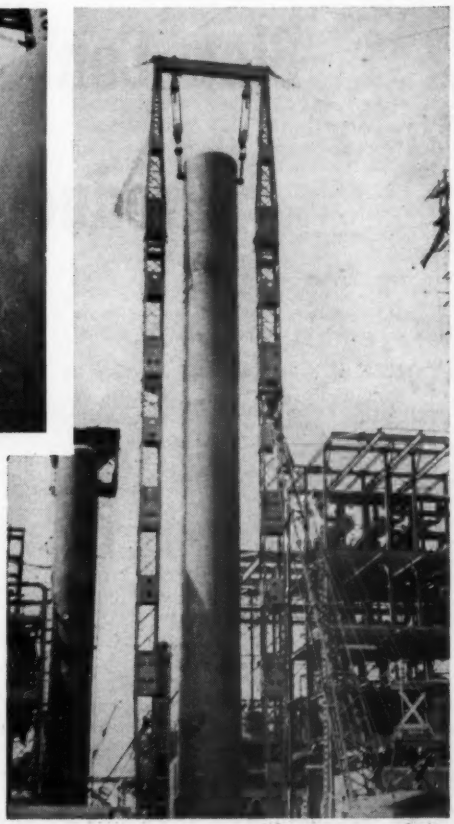
Development division: W. H. Barcus, chief of chemical engineering development; W. C. Huffman, development engineer on aviation gasoline; L. W. Omwake, leader of 15 Plant survey group; J. I. Harper, development engineer on pilot plants; E. H. Renwick, development engineer on gas problems; A. B. Kent, foreman of Pod Laboratory; L. G. Strohm, foreman of test-engine laboratory.



Installation of the 300-ton, 150-ft. debutanizer towers represented an unusual engineering feat in itself. The towers are part of the alkylation plant in Sun Oil Co.'s 15 Plant



The block at left was made to lift the huge towers in the alkylation plant. Its unusual size is apparent from comparison with the figure of the workman. In the view above block and tackle are attached to the 150-ft. debutanizer to lift it in place. The view at right shows tower in place



Interior of boiler house showing forced-draft fans in relation to boilers

Harry E. Melton, assistant superintendent of Marcus Hook refinery, is now in his tenth year with Sun Oil Co. He was born in Girard, Kans., attended the public schools in Springfield, Mo., and Decatur, Ill., and high school in Denver, Colo., and Chattanooga, Tenn. In 1916 he was graduated from University of Kentucky with a bachelor's degree in mechanical engineering.

Melton was associated with Babcock & Wilcox Co., from 1916 to 1934, in the Barberton shops and service department, New York. In 1918 and 1919 he was with the U.S. Army, serving as a lieutenant, field artillery, with the American Expeditionary Forces in France. He joined Sun Oil Co. in 1934 and since has been engaged on power-plant furnace design, combustion, the mercury vapor process, turbo-compressors and heavy equipment.

Flow Control Valve Limits Steam Production in Boiler Plant

by Harry E. Melton

WHEN it was decided, as part of Sun Oil's wartime program, to build this huge aviation-fuel arsenal, we acquired for the site of the plant a tract of 125 acres situated on the Delaware River about 1 mile below the Sun Oil Marcus Hook refinery, but separated from it by the property of Pure Oil Co. In most respects the location was isolated from the rest of the refinery and the job resolved itself into building a complete refinery with all utilities and services, offices, laboratories, storehouses, shops and units. One of the primary requirements was a new boiler house to supply all steam needed by the plant.

In order to save as much time as possible in engineering and design and to speed delivery of boilers and related equipment, the boiler house practically duplicates in arrangement and equipment a power house extension erected in the main refinery in 1938-9.

Aside from a few changes, involving no delay to the manufacturer, the boilers were duplicates of a boiler installed in the 1938 extension, and, in so far as the magnitude of the job would permit, the architecture of the 1938 building was retained, as was the arrangement of the equipment except for pumps. Due to some additional equipment being required because of the isolated site, a side bay was added to the building to accommodate feed pumps, fuel pumps and main air compressors for the new refinery.

Some guesswork was involved in selecting the number of boilers that would be required to carry the 15 Plant load. At the time the boiler order was placed we did not know what the load would be, as the plant design was just getting under way and no heat balances had been worked up. Since the delivery time on boilers was more critical than on practically any other equipment, we decided on our requirements on the basis of past performance on previously built and operating catalytic plants at Marcus Hook. A rough estimate indicated that three boilers of 75,000-lb. capacity each would be necessary and we then went ahead with our boiler-house layout, leaving room for a fourth boiler theoretically to take care of future expansion, but actually to have a place to put it if our estimate had not been psychic, which fortunately was the case.

Steam generated in the boiler house is distributed through the 450-lb. system to the six-case Houdry catalytic

cracking or treating plant, the alkylation unit and the gas-recovery and stabilization plant and boiler-house auxiliaries. In addition, exhaust or reduced pressure steam is supplied to water plant, offices, laboratory, shops and store house. The 450-lb. system supplies turbines and reboilers in the unit areas. A 180-lb. system and a 135-lb. system supplied through reducing valves and by exhaust from high-pressure equipment serve secondary prime movers and reboilers, blanking and warming lines, barometric condensers, etc., and a 40-lb. low-pressure system serves for heating load, exchangers and small reboilers. Drips and condensate from all systems are returned to the feedwater deaerating heaters in the boiler-house area. Condensate returns amount to approximately 50 per cent of the boiler output.

The boiler installation comprises three Babcock & Wilcox Type F integral furnace boilers, each having a capacity of 75,000 lb. per hour at normal load and 90,000 lb. at maximum load. Boilers are designed for 500 lb. per sq. in., and are operated at 450 lb. per sq. in. The furnaces are arranged for future pulverized coal. The boilers are equipped with B&W combination steam mechanical oil burners, ring-type gas burners, loop-type superheaters, tubular air heaters, Diamond soot blowers, Diamond water columns, Crosby safety valves and Edward nonreturn and stop valves. Sufficient superheating surface is provided to give 100° superheat to assure dry steam to turbines driving pumps, fans, etc. The superheater headers are drilled and blanks provided for a full complement of tubes if at any time in the future a full range of superheat should be required for possible power generation. At present, all electric power is purchased from Philadelphia Electric Co. and is brought into the plant through a substation located in the boiler-house area.

Each boiler has a Sturtevant turbovane forced-draft fan driven by a Carling steam turbine and a multivane induced-draft fan driven through a reduction gear by a Moore turbine. Gases are exhausted through three stub stacks on the roof having more the appearance of ventilators than the familiar 150-ft. high boiler-house stacks.

The fuel supply consists of oil and refinery dry gas; the oil being a mixture of very low-viscosity bottoms from the Houdry cases with some light fuel oil. The gas supply is a waste product from the gas-stabilization plant and varies from 1,400 to 2,000 B.t.u. per cubic foot. Gas firing has the preference, oil being burned only when there is a deficiency of fuel gas.

Combustion, steam flow and water level are controlled by Bailey automatic-control equipment, so arranged that boilers may be kept on automatic whether burning oil or gas, or both. A master steam-pressure controller on one boiler-control board can be set to master from any one of the three boilers to control pressure on one or both of the other boilers. Interlocks are provided to shut fuel off in the case of fan failure.

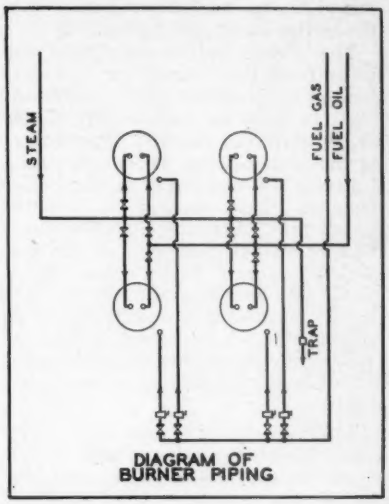
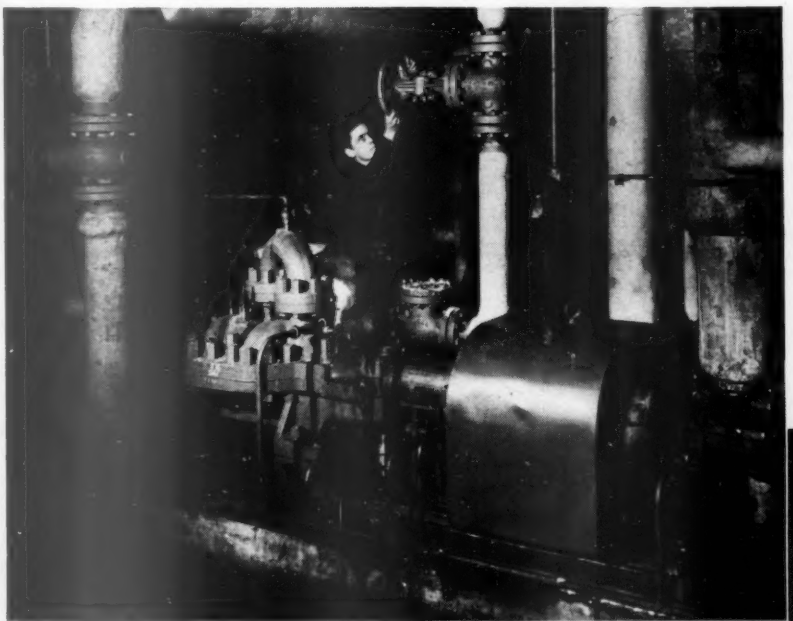


DIAGRAM OF BURNER PIPING

One unusual feature of this boiler house is that each boiler is equipped with a Fisher automatic flow control valve. These flow controllers automatically limit the steam production from each boiler to 75,000 lb. per hour and act essentially as back-pressure valves to maintain constant 450 lb. steam pressure at the boiler outlets. They thus assure that there is always normal steam pressure on the house header for the operation of the turbines driving the fans, feedwater pumps and fuel-oil pumps. With this arrangement, the refinery cannot drag steam from the boiler house at a higher rate than it can be generated, a situation which might, in extreme cases, cause a shutdown of



Left: Boiler water feed pumps in power plant. Below: The driving unit in the foreground powers the forced-draft fan with which the boilers are equipped

steam-driven auxiliaries and loss of the entire steam production.

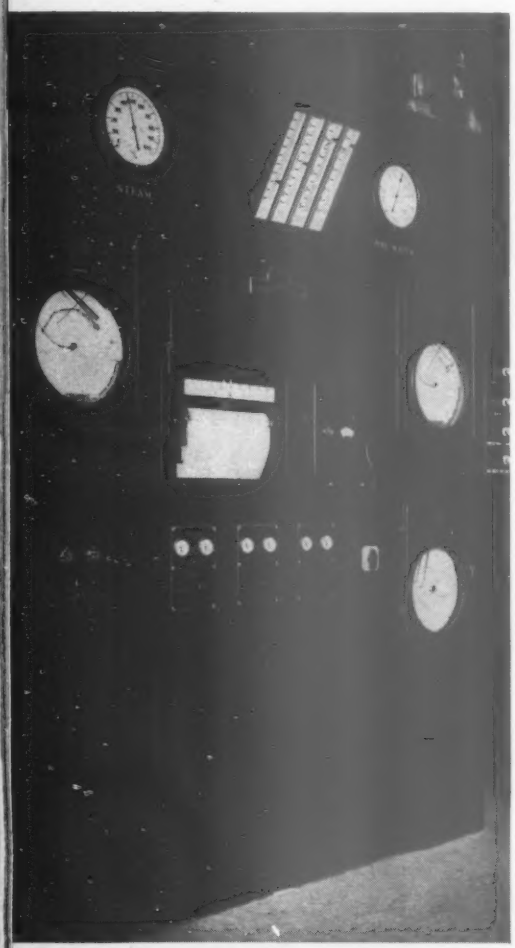
The Fisher valves take their impulse from the steam flow controller housed in the Bailey boiler meter and start to close as soon as the 75,000-lb. flow rate is reached. They return to the open position as soon as equilibrium is restored between supply and demand. This method of limiting steam production has almost entirely eliminated any tendency on the part of the refinery operators to throw a sudden increase in load on the boiler house, the consequences of which would be frequent periods of low steam pressure and interference with normal operations in the entire plant.

Safety alarms are provided on the panel board to indicate high or low water in the Elliott deaerators, low feed-water pressure or failure of plant instrument air to automatic controls. These alarms are all on one howler with each having separate colored lights.

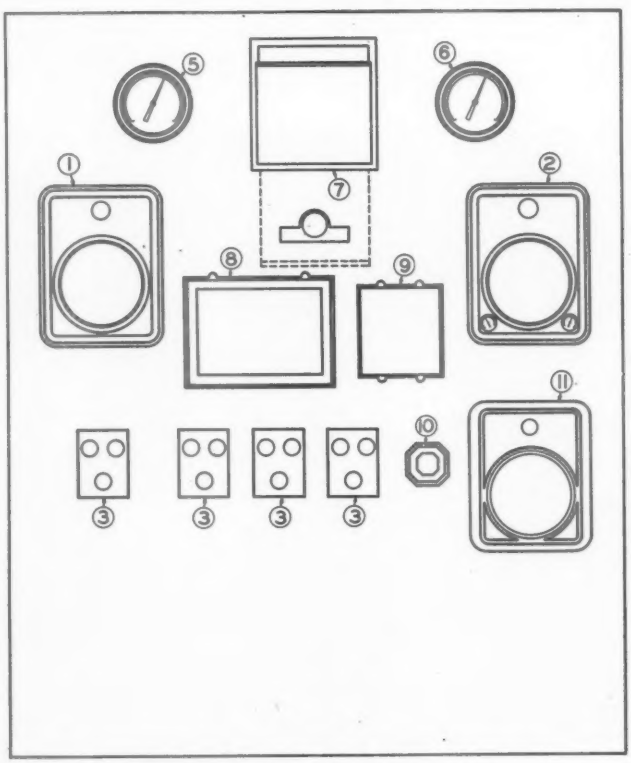
A small Westinghouse steam-driven air compressor is located on the wall at one end of the boiler house for supplying boiler control instrument air in an emergency. It cuts in automatically if plant air supply should drop to a predetermined mininum and cuts out when regular supply is restored.

At one end of the pump bay there is a switchroom housing all switches for boiler house electrical equipment. There is also in this room a pushbutton circuit-breaker control for the oil circuit breakers on the main 2,300-volt feed switches located in the remote substation serving the entire plant.

Boiler-flow control valve to prevent excessive drag on boilers



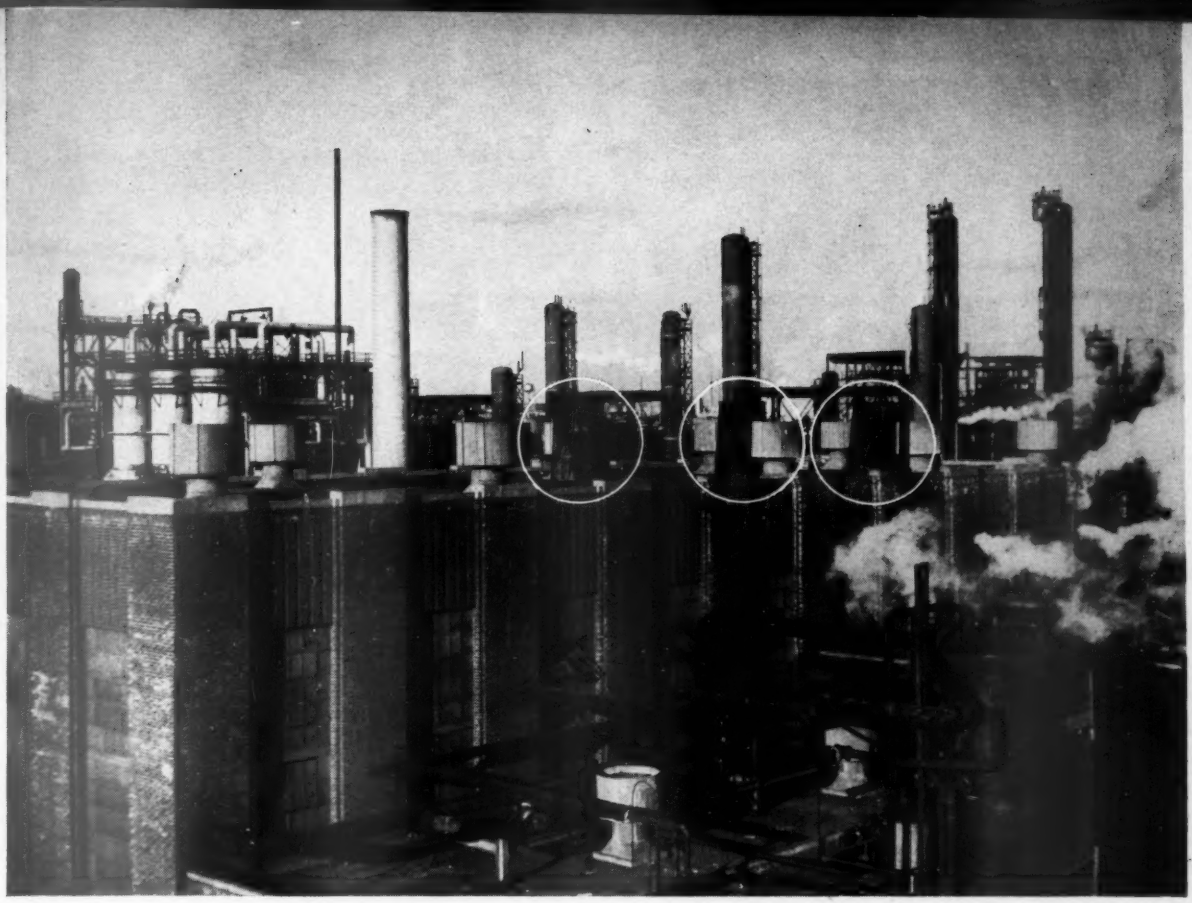
Each of the three 75,000-lb.-per-hour boilers is equipped with an individual control board, one of which is shown here



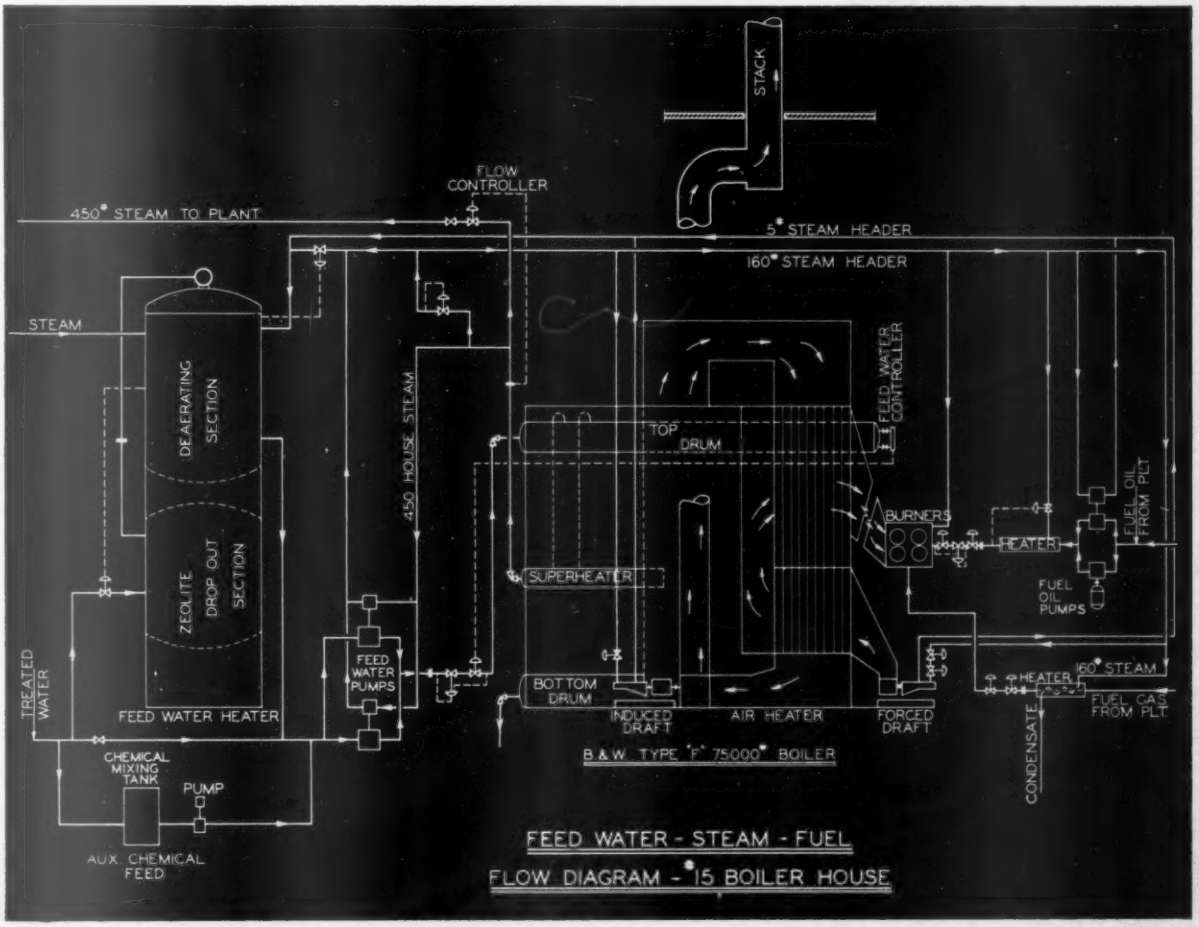
PANEL LAYOUT FOR BOILER ROOM

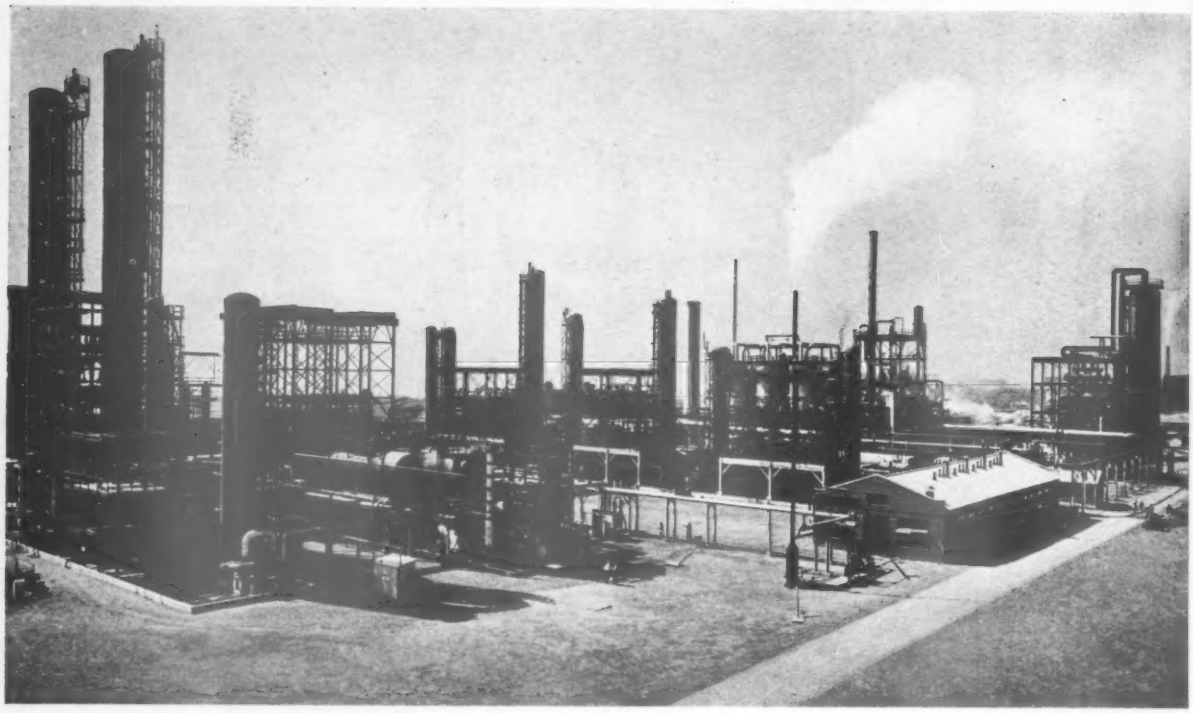
LEGEND

① BOILER METER
② PRESSURE RECORDER
③ CONTROL SELECTOR VALVES
⑤ FEEDWATER PRESSURE GAGE
⑥ STEAM PRESSURE GAGE
⑦ 4 POINT DRAFT GAGE
⑧ 12 PT. RECORDING POTENTIOMETER
⑨ INDICATING POTENTIOMETER
⑩ 12 POINT SWITCH
⑪ FUEL GAS METER



Roof of the boiler house showing the distinctive stub stacks (circled) which resemble ventilators more than conventional stacks





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Water Purification Processes Adaptable To Changing River Conditions

by Orin M. Elliott

THE Delaware River estuary can be thought of as a long tidal lake in which river flow and ocean tides tend toward an equilibrium. During most of the year the river flows are sufficient to keep brackish water 20 to 30 miles below the Sun Oil Co. refinery at Marcus Hook, Pa. Thus, except during extended periods of drought, good quality water for industrial purposes is available. In the drought periods sea-water contamination slowly moves up the river in a predictable manner. When the total flow in the river drops to less than 7,200 c.f.s. the brackish condition will eventually extend to Marcus Hook. When the drought breaks and the river flow increases the salinity slowly recedes, being displaced by water with high accumulated sewage content. During the past 15 years these fall periods of brackish river water have become more nearly the rule than the exception and in the last 3 years we have experienced two of the worst periods of sea-water contamination in the history of the refinery. These facts have changed our industrial water purification plants at Marcus Hook from fixed processes to those which are adaptable to changing river conditions. This change is reflected in the design and operation of the new water system at 15 Plant.

Fig. 1 shows the chemical conditions of brackish and normal river water at Marcus Hook, Pa., during recent years.

For 15 Plant only the makeup water for the steam boilers, the barometric condenser cooling tower and other special jackets is chemically treated. For the main cooling requirements screened river water is used. Considerations leading to this choice in preference to cooling towers were the lower and especially the more uniform river-water temperature and the fact that during droughts the high sodium and magnesium chloride would be further concentrated in cooling towers, making it highly corrosive except at an additional chemical treating cost. Other considerations were comparative costs and operating experience with previous installations.

Source of Water

15 Plant uses approximately 50,000,000 gal. of river water per day. This water is taken from an intake crib 850 ft. out in the river through two siphons consisting of 48-in. diameter steel pipes constructed on a pile dock as shown in Fig. 2. The siphons discharge into the pumphouse forebay. From this the water passes through traveling screens with ⅛-in. square openings, into the pump-suction bay. Five motor-driven main pumps and one gasoline-engine-driven emergency service pump deliver this water to the plant through a 48-in. steel pipe line. Most of this water is used for cooling purposes without further purification and returned to the river. The alkylation plant cooling water which makes up the principal load is used for two and three stages of heat exchange. Each heat exchanger is arranged so that the water flow can be reversed during normal plant operation to clean the water passages.

For boiler feed-water treatment, a process suitable for conditioning both average and brackish river water was necessary. The lowest chemical operating cost for average river water is obtained with an alum sedimentation tank, together with filters and zeolite softeners operating on the sodium cycle. Green sand zeolite softening, however, has proved unsatisfactory for extreme brackish water because of the relatively high concentrations of magnesium and chlorides. The softener capacity decreases and the regenerating salt requirements increase out of proportion

Orin M. Elliott, water - conditioning engineer, has been with Sun Oil Co. since relinquishing his association with the United States Navy Department's Engineering Station at Annapolis, Md., 9 years ago. Prior to this he was with the Fuel Economy Service of the U.S. Bureau of Mines in Washington, D. C. He has also worked for the Richfield Oil Co. in Los Angeles, Calif.

Elliott is a graduate of the California Institute of Technology, Pasadena, Calif.

FIG. 1—DELAWARE RIVER WATER ANALYSES—SUN OIL REFINERY DOCK, MARCUS HOOK, PA.

(Parts per million)

Year	Date of sample	Chlorides as NaCl	Soap hardness as $CaCO_3$	Calcium as $CaCO_3$	Magnesium as $CaCO_3$	Total alkalinity as $CaCO_3$	pH value	Type of sample	Notations
1943	October 26	2,790	812	...	...	51	6.7	24-hour wickdrawn	Maximum recorded salinity
	October 12	1,695	394	109	256	62	6.6	24-hour composite	Typical drought conditions
1942	August 8	27	86	50	35	50	6.7	24-hour composite	Typical good summer water, no 1942 drought
1941	November 4	2,040	580	121	...	55	6.8	24-hour composite	Maximum salinity for year
1940	October 31	150	91	...	...	...	...	24-hour wickdrawn	Maximum salinity for year
1939	September 30	756	...	...	...	...	...	24-hour wickdrawn	Maximum salinity for year
1938	September 14	50	...	...	...	...	...	mean tide spot samples	Approximate maximum salinity for year
1937	October 18	125	...	...	...	...	...	mean tide spot samples	Approximate maximum salinity for year
1936	October 10	825	...	...	...	...	...	mean tide spot samples	Approximate maximum salinity for year
1935	October 14	330	...	...	...	...	...	mean tide spot samples	Approximate maximum salinity for year
1934	September 3	250	...	...	...	...	...	mean tide spot samples	Approximate maximum salinity for year
1933	August 10	165	...	...	...	...	...	mean tide spot samples	Approximate maximum salinity for year
1932	October 4	1,750	...	...	...	...	...	mean tide spot samples	Approximate maximum salinity for year
1931	November 20	1,600	...	...	...	...	...	mean tide spot samples	Approximate maximum salinity for year
1930	November 12	2,000	...	...	...	...	...	mean tide spot samples	Approximate maximum salinity for year
1929	September 8	600	...	...	...	...	...	mean tide spot samples	Approximate maximum salinity for year

to the increase in hardness. As drought conditions become worse, soap tests for control purposes become less satisfactory. Finally, both regenerating salt and rinse-water requirements become grossly excessive. At this point zeolite softeners fail and pass hardness to the boilers. This condition necessitates another type of treatment for boiler-feed water during periods of sea-water contamination. It would be possible to desalt the water but the equipment and chemical operating costs would be high. The economical solution has been found in lime and soda, or caustic soda precipitation of the magnesium and part of the calcium hardness in the sedimentation tank followed by flue-gas recarbonation, ahead of the filters and zeolite softeners. With this process the efficiency of zeolite softeners during salinity conditions is improved. The bulk of the softening operation takes place in the settling tank. When the precipitation is complete and properly controlled, this softening in the settling chamber is closely proportional to chemical requirements.

With a sedimentation chamber suitable for alum coagulation or for lime and soda (or caustic soda) precipitation these two processes can be combined in one plant. Only a recarbonation system is required as additional equipment to obtain this flexibility. Alkalinity feeders are required in either case. This has been done at both No. 1 and No. 15 water-treating plants at the Marcus Hook refinery.

Design Modified

The Spaulding precipitator design has been modified to provide a reaction and sedimentation chamber suitable for either alum coagulation or caustic magnesium precipitation. The 15 Plant "coagulator precipitator" is a 60-ft. diameter, 30-ft. high cylindrical steel tank baffled as shown in Fig 3. For recarbonation a flue gas ebullition chamber 15 ft. in diameter by 30 ft. high is located alongside and arranged for gravity collection from storage at top of the "coagulator precipitator." The settled water passes downward through the recarbonation tank whether or not the flue-gas system is in use. Water from the recarbonation tank passes through a 16-in. diameter line to the main pumps in the water-treating plant building. These pumps discharge to five 8-ft. diameter by 18-ft. long horizontal pressure filters. From here part of the filtered water passes through four 10-ft.-diameter 1,800-kilogram, downflow, green-sand, zeolite pressure softeners. Filtered water without zeolite softening is supplied to the cooling tower for the barometric condensers, and to certain bearing jackets and special coolers from which it is recovered.

The zeolite softened water is distributed directly to low-pressure deaerating feed-water heaters at 15 Plant, and to 10 Plant for existing and building aviation-gasoline units. The Nos. 15 and 10 water-treating plants are interconnected by an 8-in. steel pipe line. The necessity for a clearwell and secondary distributing pumps at the No. 15 water-treating plant has been eliminated by including a closed zeolite settling chamber in the elevating skirt section of the feed-water heaters. As a result of age or abuse, zeolite softener beds inevitably become "upset." These pressure settling chambers prevent loose zeolite from getting into the hot part of the deaerators where it would disintegrate to form scale in the boilers.

The No. 15 water-treating plant has a 1,400 g.p.m. motor-driven main pump and a steam turbine operated pump. The turbine pump is connected as the spare for either the main pump or the motor-driven backwash pump.

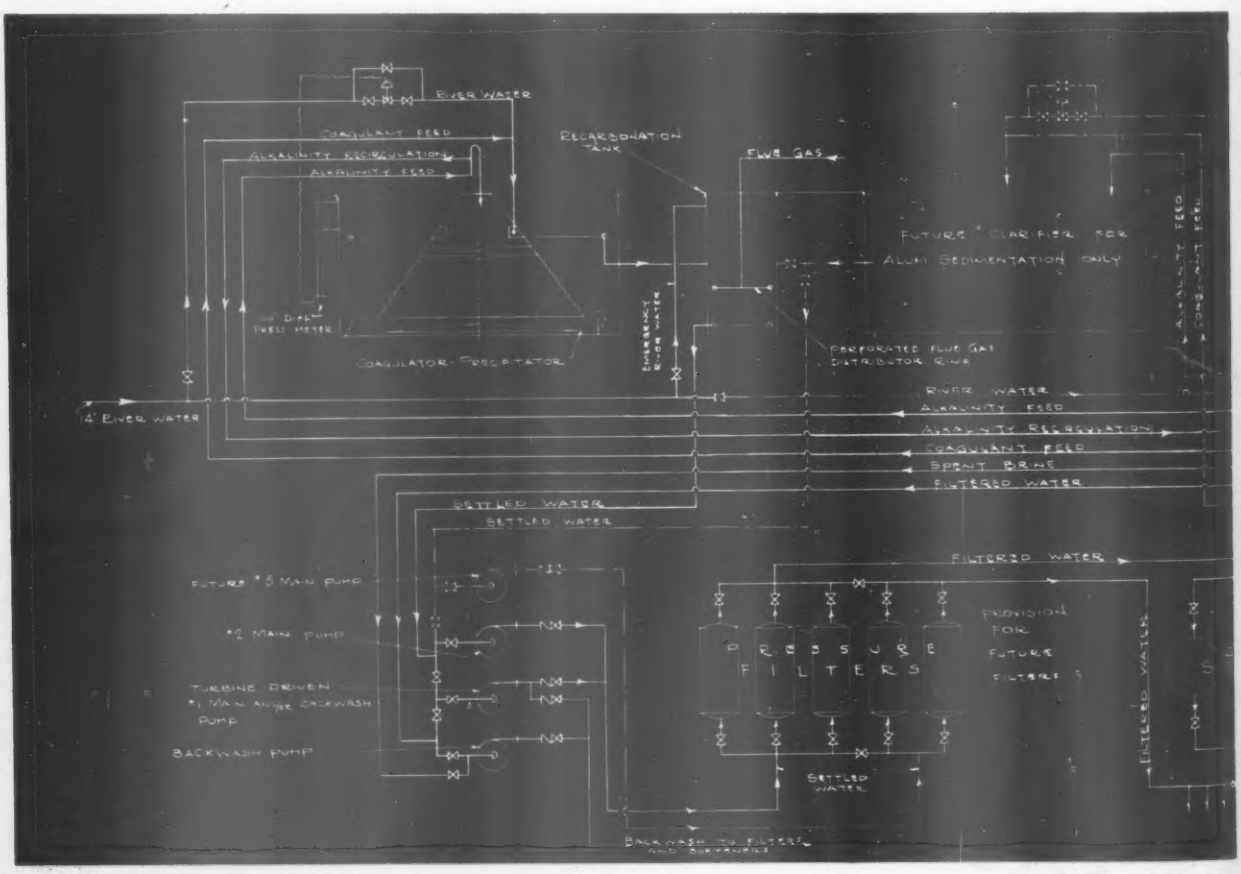
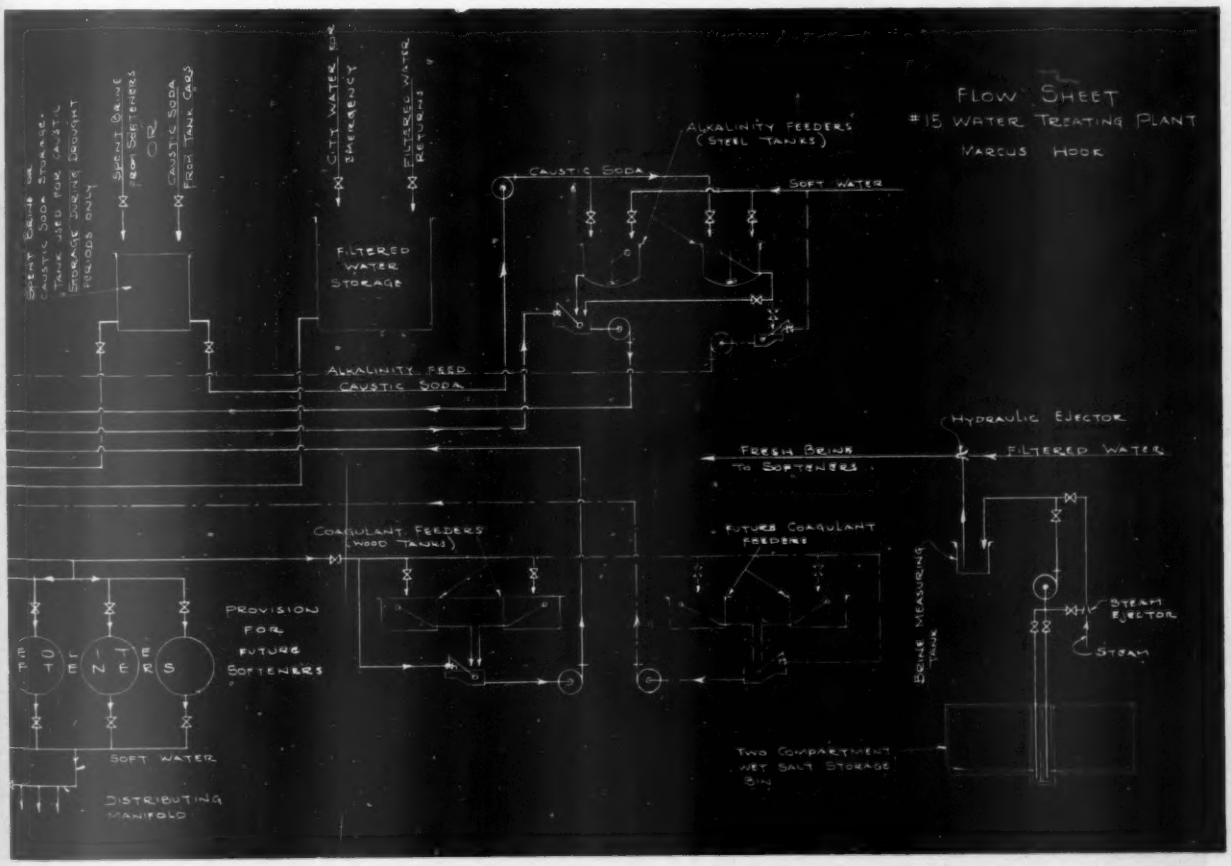


Fig. 3: Flow sheet of

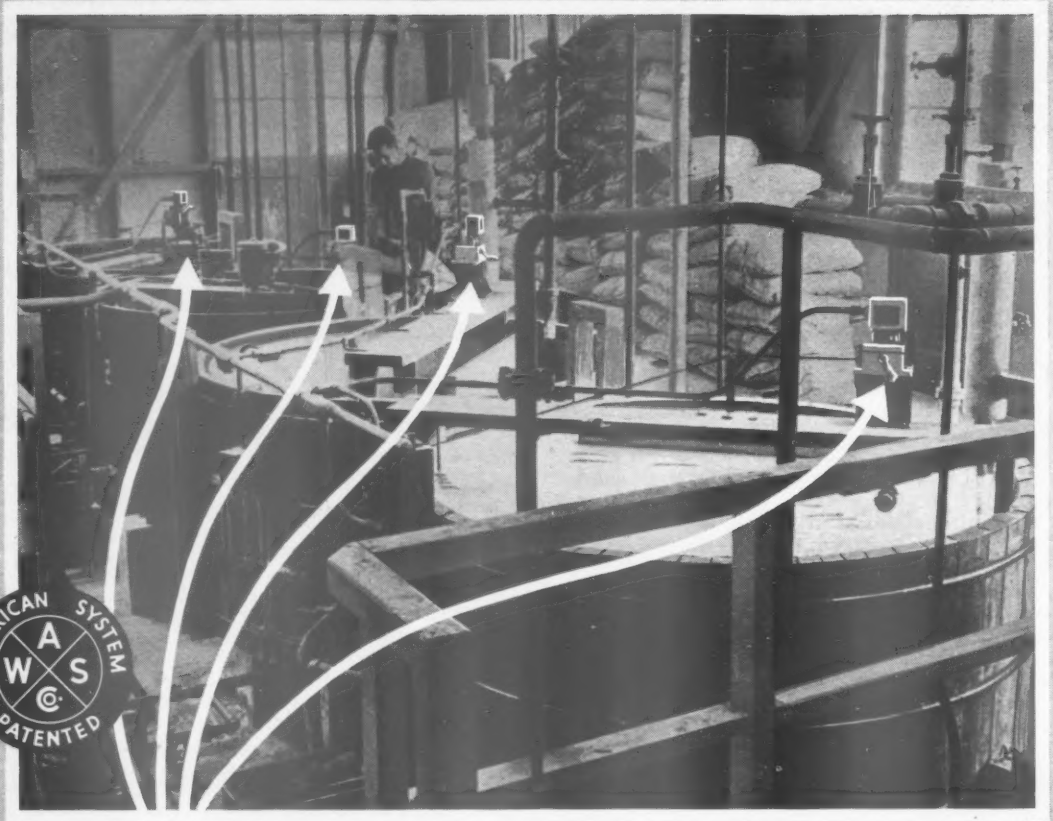
Filtered water returning from bearing jackets and coolers in the 15 Plant boiler house is stored in an 18 by 18-ft. steel tank and is reused for backwashing filters and rinsing softeners. Zeolite softeners are backwashed with spent brine from a 15 by 15-ft. steel-storage tank. Thus, the brine reclaiming and softener backwashing operations have been combined, saving water, time, and a spent brine transfer pump. During drought periods the spent brine storage tank is used to store liquid caustic soda. This is practical because of low softener backwash requirements with the low turbidity obtained during caustic magnesium precipitation and because the brine reclaiming operation is of only slight value during brackish periods.

Salt for zeolite softener regeneration is stored in a two-compartment underground concrete wet storage bin. Each compartment will hold one 125,000-lb. box car load of rock salt. The salt is mechanically unloaded from railroad cars into the storage bins by means of a "box car salt unloader" consisting of a portable bucket elevator and telescopic chute arrangements which delivers salt to bin openings at railroad-track level. Clear brine is transferred from the wet storage to the brine measuring tank

Fig. 2: Forty-eight-inch siphons extending 850 ft. into river through which plant gets 50,000,000 gal. of water per day



water-treating plant



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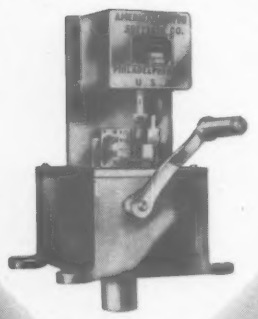

The HEART

of the Marcus Hook Refinery's Corrective Chemicals Application System

The rate of flow of the untreated water varies from time to time. The dosage of corrective chemicals varies, also, in direct and exact proportion. This is accomplished automatically and with precision by means of the American Electro-Magnetic Proportioner.

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Fig. 4: Chemical feed tanks in water-treating unit

by means of a high lift self-priming centrifugal pump. The measured brine is then passed through the zeolite softeners by hydraulic injection.

The pressure sand filters are backwashed with filtered water. The backwashing operation is improved by horizontal perforated surface-wash pipes. These are independently operated from the separate backwash system. The chemical feed tanks are arranged for easy handling of chemicals. The arrangement is shown in Fig. 4. During normal river conditions alum and small quantities of soda ash are fed to chemical pump-suction boxes from two wooden and two steel tank coagulant and alkalinity solution feeders working in alternate service with automatic tank switching mechanisms. The chemical feeds are proportioned automatically to settling tank influent through solenoid cable release mechanisms which lower the solution drawoff lines. Rubber hose is used for the drawoff line swing joints. During drought periods liquid caustic soda will be fed proportionately from the alkalinity feed tanks. For the brackish water condition which occurred soon after the plant was put into operation in the summer of 1943, the caustic-soda equipment was not complete. Hydrated lime and soda ash were mixed in the alkalinity feed tanks by their motor agitators. However, this temporary measure involved excessive manual labor.

With lime and soda and with caustic soda softening at Nos. 1 and 15 water-treating plants last fall no supplemental coagulant feed was required. The precipitating magnesium hydroxide furnished an abundance of flocculating material so that "visibility stick" readings of as much as 12 ft. were regularly obtained. The lime and soda (or the caustic soda) feed during the brackish period with large tidal swings for the river water magnesium content was controlled by regular titrations for the free caustic alkalinity at the precipitator throat. With a few days' experience the plant operator handled this work along with his other duties without the help of a chemist and maintained the free caustic alkalinity within desirable limits. Fig. 5 shows the free caustic alkalinity or pH value which is necessary in order to depress the magnesium hardness to various residuals. The control of the recarbonation system was also found to be much simpler than was anticipated.

The efficient removal of the large

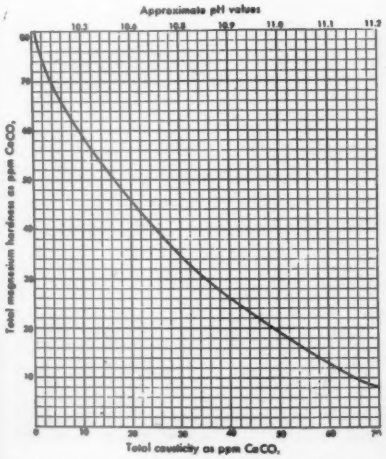

Fig. 5: Causticity magnesium pH equilibria. Courtesy Permutit Co.

Fig. 6: The general layout of the water-treating plant is apparent from this aerial photograph of the unit

Fig. 7: A.P.I. separator of water-treating plant

volume of sludge with lime and soda softening operation was possible only through the use of an automatic desludging system. This equipment consisted of air-operated diaphragm valves with solenoid pilots and electric timer.

The foundation conditions for the No. 15 water-treating plant were such that it was necessary to drive piles for all parts of the building and for the larger tanks. The underground lines, the pipe supports and the filter and softener foundations are locked together by reinforced concrete beams, piers and pads which are supported on piles so that piping strains due to unequal settlement cannot develop in the cast-iron valves which are used throughout the plant. As a wartime measure, the building is of timber frame construction with roof and side walls of transite.

The general arrangement of the plant is shown in Fig. 6. Space has been provided for additional filters and softeners as plant requirements increase. If large-capacity circulating-water cooling towers are eventually added in the area served by this plant, a second settling tank for alum coagulation only will ultimately be necessary and space for this has been provided. During normal river-water conditions the two settling tanks will operate in parallel with alum clarification. During drought periods the water plant operation will be split into two independent systems. Caustic magnesium precipitation and recarbonation will take place only in the existing tanks producing medium high bicarbonate water for zeolite softened boiler feed. The future settling tank will continue with alum clarification during droughts, delivering unsoftened low bicarbonate water through filters for the cooling towers. The future dual system operation is indicated in the Fig. 3 flow sheet. The No. 1 water-treating plant, which serves a number of large cooling towers as well as boiler houses, already has the equipment for this ideal dual system. It has been found that with the help of hexa-meta phosphate, drought conditions can be made tolerable for cooling-tower systems as well as for the boiler houses.

The 450-lb. pressure boilers receive an auxiliary feed-water treatment consisting of disodium ortho phosphate, sodium sulfite and quebracho tannin mixed in suitable proportions and pumped continuously into the boiler feed-pump suction manifold by means of an adjustable stroke motor-driven plunger pump at the boiler house. Continuous phosphate feed is practical because of low residual hardness in the makeup water. The auxiliary boiler feed-water treatment, the flash type continuous boiler blowdown equipment and the deaerator operation is checked and controlled by routine tests for boiler-water alkalinity, chlorides, sulfates, sulfite, hardness and degasified steam condensate conductivity. These tests are made by the boiler plant operators. The laboratory makes only a weekly check.

The 15 Plant boilers were put into nearly full-load operation in August 1943. From August through October the most severe period of brackish water in the history of the refinery developed. In November, after the river had returned to normal, one of the boilers was opened for inspection and found to contain only a slight powdery deposit. This deposit was insufficient to justify removal by water flushing. During the drought the boilers operated with roughly 50 per cent makeup water and with boiler water concentrations up to and above 18,000 p.p.m. total solids with apparently no significant "carry over" in the steam. Regular plant tests of the steam condensate conductivity for degasified samples gave results indicating less than 1 p.p.m. total solids in the saturated steam leaving the boilers. These surprising results will be studied more exhaustively during the next brackish period.

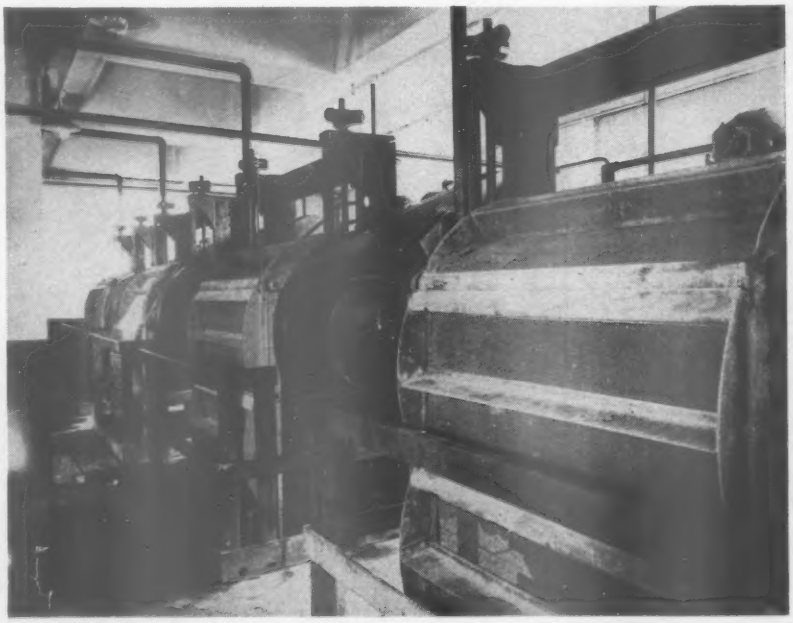

Fig. 8: Traveling screens in water plant through which water passes en route to the pump suction bay

Equipment for Reverse Circulation

by Harry F. Simons

This is the second of three articles on reverse circulation. The first appeared in the issue of January 20, and dealt with the carrying-capacity streams of various velocities. The third article will consider applications of reverse circulation and will appear in an early issue.

EQUIPMENT used for reverse-circulation work varies with the type of job being performed, the depth of the well and to some extent the machinery which happens to be available. It may range from a complete rotary rig which has drilled the hole and set pipe to only a light pulling unit, pump and prime mover. Sometimes, however, a rig designed specifically for the purpose is used.

Any well being drilled by the rotary method with proper blowout-prevention equipment, or any producing well equipped with casing, tubing and a stripper-type tubing head can be reverse circulated with very little trouble. The circulating pump discharge needs only to be connected to the fillup line (a 2 or 3-in. line to the casing below the blowout preventer) of the drilling well, or to the casing wing on a producing well. Closing the blowout preventer on the drilling well then permits circulation down the annulus and up through the drill pipe; in the producing well the stripper-type head already has the annular space sealed off so it is only necessary to start pumping fluid into the annulus.

Use Tubing for Drill Stem

While any type drill stem may be used, the tubing installed for the producing string in the oil well is most generally employed. This obviously eliminates the necessity of hauling a special string of drill pipe to the location for the purpose of completing or recompleting the well. At first tubing was used with some trepidation as it was not known how much drilling abuse it could withstand and still be used for a producing string. A recent operation[1] in which tubing was used to deepen a well over 600 ft. through hard dolomite has demonstrated that there need be no fear of damage to the tubing in the ordinary reverse-circulation job.

The tubing has one outstanding advantage over drill pipe (with the exception of internal flush drill pipe) and that is its lack of internal restrictions such as occur at the upsets and tool joints of drill pipe. (Table 1.) Also, the tubing collars do not have the thickness of tool joints so there is less wear and damage to the rubber in the blowout preventer when the pipe is pulled or run. There is also the reduction in weight and the consequent reduction in the size of draw works and prime mover required for pulling and running the tubing. Tensile strength of N-80 tubing in feet of drill stem is slightly greater than Grade D drill pipe[2] while J-55 tubing has 86.75 per cent of the tensile strength and H-40 has about 70.82 per cent. (Table 2.)

When using tubing for a drill stem a bit with a tubing thread on the shank is often employed although in some cases a bit with a tool-joint thread may be used along with a tubing-thread tool-joint sub. A drill collar is not used except in cases where a larger hole is being drilled and drill pipe is used for a drill stem. The tubing is handled like drill pipe and if facilities are available it is spun out and spun up while making trips with the rotary or drill-stem-turning mechanism.

Bits employed in reverse-circulation work do not have any water courses in them but a hole approaching that of the internal diameter of the tubing is cut in the bottom of the bit so that even large pieces of cuttings or formation can get into the drill stem and start to the surface.

Another slight alteration in the drill stem is the insertion in the string just above the bit of a nipple having three small (3/32-in.) holes around its circumference. By blocking off below these holes and then establishing normal circulation, a jetting action against the wall of the bore hole can be produced.

TABLE 1—DIMENSIONS OF DRILL PIPE AND TUBING

Size o.d. (in.)	Size i.d. (in.)	Wt./ft. (lb.)	Couplings o.d. (in.)	Upset i.d. (in.)
Drill Pipe				
2⅜	2.00	4.80	3.125	1 7/8
2⅜	1.815	6.650	3.125	1⅛
2⅞	2.469	6.45	3.750	1⅞
2⅞	2.323	8.35	3.750	1⅝
2⅞	2.151	10.40	3.750	1 3/8
3½	3.063	8.50	4.250	2 7/8
3½	2.900	11.20	4.250	2⅛
3½	2.764	13.30	4.250	1⅞
3½	2.602	15.50	4.250	1¾
Tubing (EUE)				
1½	1.610	2.90	2.500	1.516
2	1.995	4.70	3.063	1.901
2½	2.441	6.50	3.668	2.347

TABLE 2—TENSILE STRENGTH OF TUBING AND DRILL PIPE
Grade D Drill Pipe

Size (in.)	Wt./ft. (lb.)	Ultimate strength (tensile) 1,000 lb.	1,000 ft. of pipe with S.F. = 2.5
2⅜	4.80	135	11.6
2⅜	6.65	193	11.6
2⅞	6.45	179	11.0
2⅞	8.35	237	11.3
2⅞	10.40	300	11.5
3½	8.50	236	11.1
3½	11.20	317	11.3
3½	13.30	380	11.4
3½	15.50	452	11.7
Tubing (EUE)			
1½ H-40	2.90	57.9	7.9
1½ J-55	2.90	69.9	9.6
1½ N-80	2.90	80.9	12.4
2 H-40	4.70	94.5	8.0
2 J-55	4.70	114.0	9.7
2 N-80	4.70	147.0	12.5
2½ H-40	6.50	131.0	8.1
2½ J-55	6.50	159.0	9.8
2½ N-80	6.50	204.0	12.6

Drill-Stem Drive

There are some cases in which reverse circulation is used without turn-

ing the drill stem but these are so few that they can be ignored and they could not be considered as reverse-circulation drilling. In such cases no equipment is needed for turning the drill stem, the packing off of the annular space being all that is required.

Three principal arrangements are presently employed for turning the drill stem. Included are: (1) Regular rotary drilling equipment with a blowout preventer which will permit rotation of a kelly joint in it; (2) use of a rotary table, gripping device between the rotary table and a round grief stem (grease joint), and a blowout preventer designed for tubular material only or a stripper-type tubing head;[3] and (3) use of a drilling head which will turn the drill stem at the same time it packs off around it. The latter is used widely on rigs designed for reverse-circulation work only while the first two are employed mainly on rotary-drilling rigs which are only temporarily engaged in completion or recompletion work, or on rigs built around already available equipment.

With all type heads there is generally used a ram-type blowout preventer which is installed on the casing immediately above the master gate. This can be used for controlling the well in case the rubber in the blowout preventer becomes worn and starts to leak while the drill pipe is in the hole. It also is an added safety feature and insures against the well getting out of control.

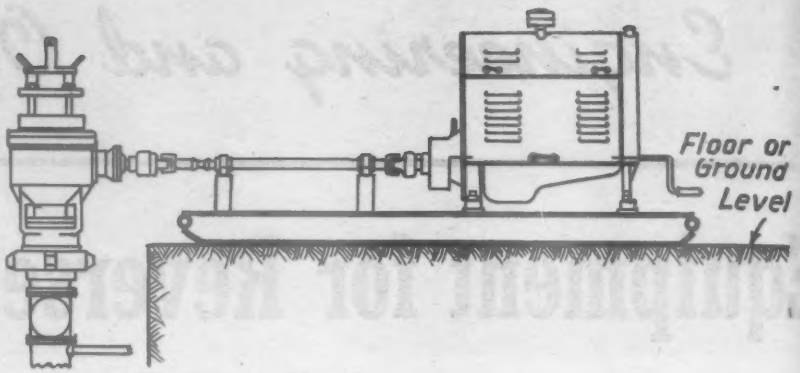

Fig. 2: Schematic drawing showing individual engine driving pack-off type head which turns the drill stem. Such an arrangement is used when servicing truck is employed for handling the tubing and an individual pump and engine unit provides fluid for circulation. When an electric motor is used to drive the head, arrangement is similar

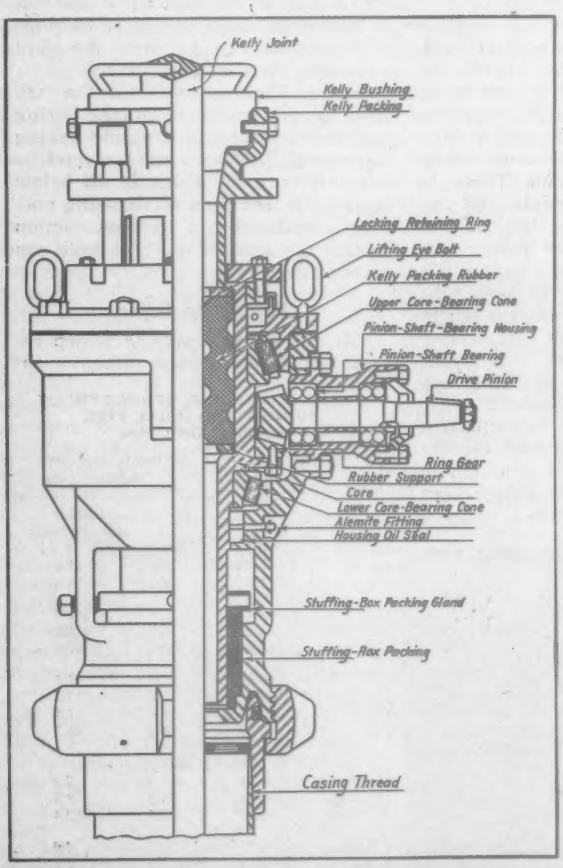

Fig. 1: Diagram of head which drives kelly joint and drill stem and packs off around them at the same time. Any suitable prime mover can be attached to the drive pinion. A kelly joint of any shape can be used

There are several types and makes of blowout preventers which will permit drilling under pressure and the rotation of a kelly in them available for such work. Some will take a square kelly while for others a hexagonal or fluted kelly is recommended.[2] One type which has been used quite widely for drilling considerable footage under pressure and for reverse circulation consists of a kelly packoff and a pressure-operated drill-stem packoff.[4] The latter is released while the former is in operation but is closed after the kelly is picked up above it. The kelly packoff remains on the kelly at all times, being removed from the body of the control head when a connection is to be made and then reinserted and locked in place in the head body before drilling is resumed.

Any type of high-pressure blowout preventer or tubing head which will strip collars or tool joints can be used with the second arrangement above as the grief stem, or grease joint, is round. However, scoring of the grief stem causes severe wear of the rubbers and they must be replaced frequently if care is not taken to see that there is no roughness, or that none develops, on it.

One arrangement for transferring the drive from the rotary table to the round grief stem which permits continuous lowering of the drill pipe is a set of roller-type grips in a square case about 3 ft. in length; the outside of the square is the same size as a 6⅝-in. kelly and it fits into the kelly bushings. The case, with the serrated rollers in it, breaks in half across the diagonal of the square and lugs and bolts with thumb nuts are provided so that it may quickly be put on and removed from the grief stem. This is necessary each time a connection is made.

A more rudimentary method which is occasionally used is to place a vertical post in the rotary table (breakout post) and a set of heavy chain tongs on the grief stem; then as the rotary turns, the drill stem turns also. The grief stem can only be lowered or raised the length of the breakout post without changing the position of the chain tongs on it.

The drilling head which is used for both driving the drill stem and at the same time packing off around it is shown diagramatically in Fig. 1.[5] It consists of a heavy body attached to the casing in which there is a pinion and ring gear, a drive shaft, and a rotating packoff element. A set of drive bushings goes between the rotating element and the kelly. A square, hexagonal or fluted kelly can be used with it, the annuluar space remains packed off at all times and the drill stem is raised and lowered at will. A split-type tubing spider

can be placed around the tubing and on top of the rotating element when either a connection or trip is to be made. The body of the head is attached by a union to the casing or blowout preventer and it can be quickly installed and removed.

Source of Power

On rigs employing a rotary table for turning the drill pipe the standard driving arrangement with only slight variations is used and it will not be further discussed here. The packoff-type drilling head has a shaft extending from the pinion gear to which a universal joint and a drive shaft can be attached. This shaft may be driven through V-belts and sheaves from the regular rotary drive of the rig or it may be powered by an individual, direct-connected prime mover. The driving arrangement to the head is very flexible.

One common method is to use an engine mounted on a frame, or skids, which can be set on the concrete platform around the well or on sills close to the well head. The frame includes supports with pillow bearings for the drive shaft. Another method is to set an electric motor mounted on a light frame on the derrick floor and connect it to the head through a shaft and a pair of universal joints. Care is taken to fireproof the engine and to use an explosionproof motor. The connection between the head and the prime mover should not be too rigid as either the head or the prime mover, or both, is subject to movement which will place a strain on the pinion gear and shaft bearing.

The prime mover employed need not be large as the drill stem is light because tubing is generally used with such heads. Also the bits are quite small, rarely being as large as 6¼ in. and generally being less than 5-in. The speed of rotation rarely exceeds 100 r.p.m. and the weight carried on the bit is much less than in normal drilling, the maximum being five points on the indicator.[7] A 15-hp. electric motor or a 25 to 35-hp. engine is sufficient for wells of medium depth (7,000 ft.) and on shallow wells even a smaller prime mover can be used.

Hoisting Equipment

Well-servicing hoisting equipment

(Continued on page 128)

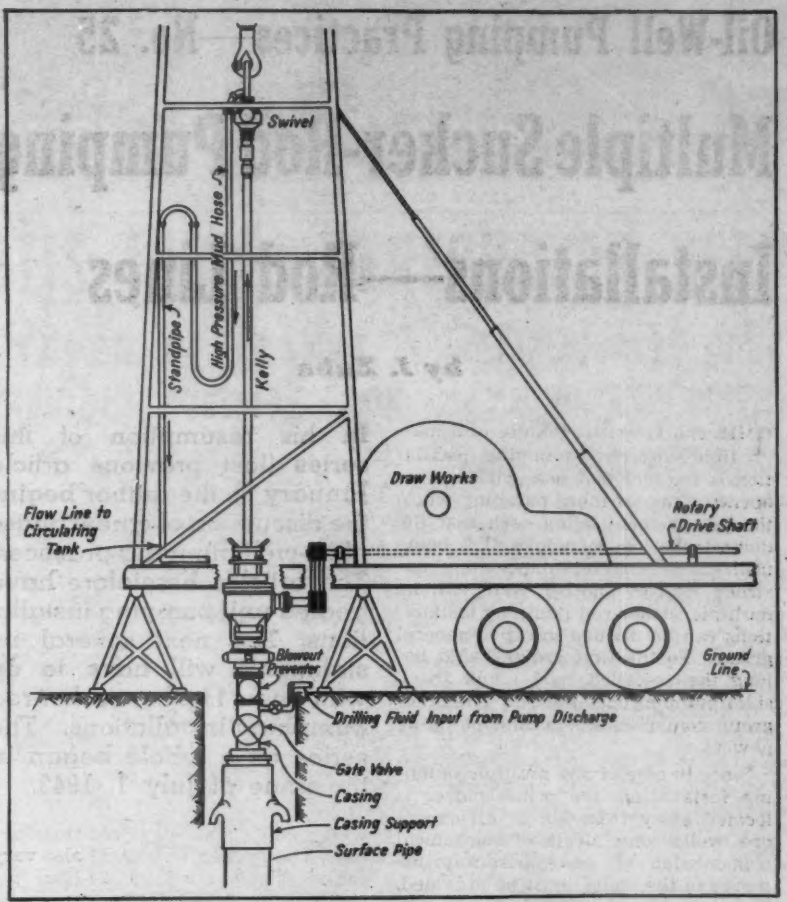

Fig. 6: Diagram of portable unit operating as reverse-circulating rig with pack-off type kelly drive

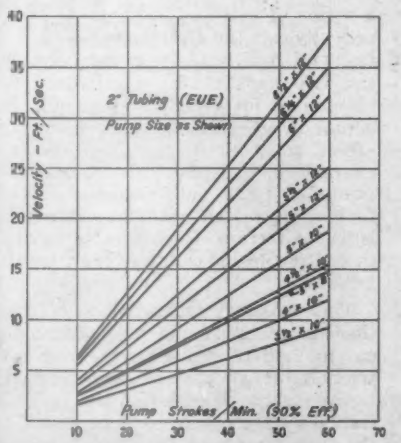

Fig. 3: Velocity of fluid in 2-in. E.U.E. tubing with pumps of different sizes operating at from 10 to 60 s.p.m.

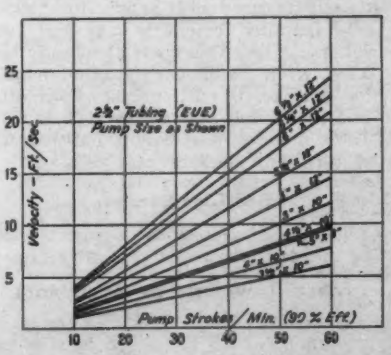

Fig. 4: Velocity in 2½-in. E.U.E. tubing with pumps of various sizes operating at from 10 to 60 s.p.m.

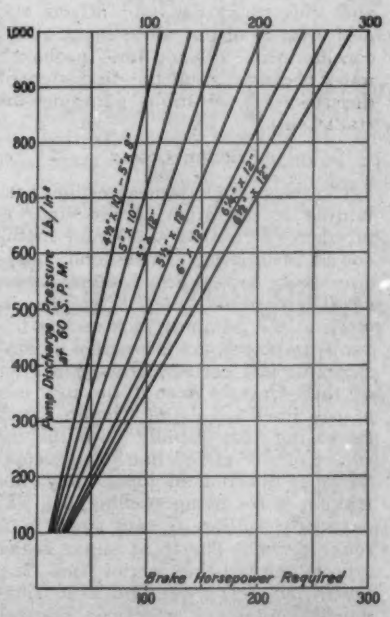

Fig. 5: Chart showing brake horsepower required for various-size pumps operating at 60 s.p.m at pressures from 100 to 1,000 lb. per sq. in.

Oil-Well Pumping Practices—No. 25

Multiple Sucker-Rod Pumping Installations—Rod Lines

by J. Zaba

In his resumption of this series (last previous article January 6), the author begins the discussion of a new phase of oil-well pumping practices. The articles heretofore have treated unit pumping installations. The next several installments will have to do with multiple sucker-rod pumping installations. The series as a whole began in the issue of July 1, 1943.

THE characteristic feature of a multiple sucker-rod pumping installation is the fact that one prime mover operates two or more pumping wells, the arrangement being such that the downstroke load of one well is being utilized to counterbalance the upstroke load of another well. All the multiple sucker-rod pumping installations can be divided into two general groups. To the first group would belong the so-called back-crank (back side) pumping installations. The other group comprises the central pumping powers.

Since in case of any multiple pumping installation, the prime mover is located away from all, or all except one, wells, some means of mechanical transmission of power, from prime mover to the wells, must be provided. This function of transmission is performed by the rod lines. Since the rod lines are a characteristic feature of any multiple pumping installation, and since their behavior affects the performance of the whole installation, consideration of rod-line problems must necessarily be the first step of discussion of multiple pumping installation.

Friction Losses

The most important question pertaining to operation of rod lines is problem of friction losses and methods of installation which tend to reduce these losses. The friction losses, which represent the difference in work at the pumping jack and at the pumping power, are a function of considerable number of factors. The first of these factors would be the size of rod lines used, the friction losses increasing very rapidly with the increase of size of rod line.[1] The second factor is question of topography, the friction losses being smaller in a flat or gently rolling terrain than in a rough terrain. The third factor is the type of the rod-line carrier used. The fourth factor is a question of lubrication. Maintenance of proper lubrication of rod-line supports, under ordinary field conditions, is very difficult. At the same time there exists a very wide variation in friction losses of well-greased and dry rod-line carriers. The friction losses will also vary considerably during the 24-hour period due to changes of consistency of the lubricant.[2] The fifth factor is the rate of travel of the rod line expressed by the product of length of stroke and number of strokes per minute of the line.

With so many factors affecting the magnitude of the friction losses of rod lines the data on these losses must be based on averages of experimental work. It appears to be a consensus[3,4,5,6] that the average coefficient of friction of rod lines is from 0.2 to 0.3. That means that for average conditions for each 1,000 lb. of weight of rod lines a pull of from 200 to 300 lb. is needed to overcome friction. For freshly greased doll heads, for properly installed catenary sags and for roller carriers this coefficient may be 0.1 or even lower. On the other hand, for doll heads with grease worn off, this coefficient may be as high as 0.6. Table 1 gives the weight per 100 ft. of different sizes of pull rods.

Rod-Line Carriers

The types of rod-line supports can be divided into three general groups:

TABLE 1—WEIGHT OF PULL RODS

Size of rods (in.)	Weight per 100 ft.-lb.
⅝	115
¾	169
⅞	225
1	295

(1) Hardwood "doll heads" used in conjunction with straight rod lines or with catenary sags; (2) roller carriers, more efficient, but also more expensive, than other methods of support; (3) a very large group of miscellaneous types of carriers designed and constructed by individual operators, local machine shops, engineering departments of oil or supply companies. Some of these carriers have been described in technical literature,[7] some are, probably, not known outside of the limits of the lease on which they are used. Efficient performance of some of them is a credit to the ingenuity of their designer. Others fail under severe conditions of actual field operation.

The question of rod-line carriers should be considered not only from the standpoint of mechanical efficiency but also from the standpoint of cost of installation and maintenance. It should be remembered that multiple pumping installations are generally used on wells of small production where the question of cost is of primary importance, if the property is to be maintained above the level of economic limit. Rod-line carriers could be easily designed and constructed which would perform with practically perfect efficiency from the purely mechanical standpoint. Their cost, however, would be prohibitive for the type of production handled by the rod lines. A compromise therefore has to be reached between mechanical efficiency and cost. Under certain conditions installation of rod lines in form of the so-called catenary sags appears to fulfill the requirements of such a compromise.

Catenary Sags

If a perfectly flexible chain, cord or rod of uniform density is suspended between two points of support the natural shape the chain, cord or rod will assume is called the catenary curve. If a rod line was installed in a series of catenary sags, then, theoretically, all the friction between rod line and doll heads, located between the two ends of the sag, would be eliminated for given rod-line pull. In actual practice no true catenary sag effect can be attained because of changes of rod-line pull during the pumping cycle and because of the factors associated with the characteristics of terrain. Considerable saving in friction losses can, however, be attained.

The catenary suspension of rod lines is probably the most economical method of reducing the rod-line friction. It should be remembered, however, that the method has its limitations. Its economy is dependent on the type of terrain in which installation is to be made. The method is particularly adapted for a gently rolling terrain.[8] Whenever special exca-

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Sub-Surface Tools

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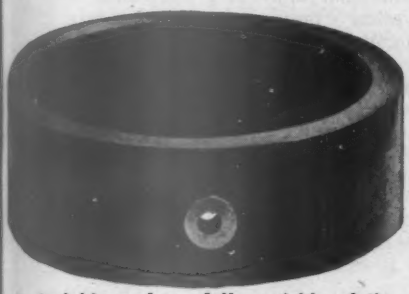

A straight-on view of the outside of the tubing showing the tapered cylindrical insert in place. Note the lack of distortion and the perfect fit of the insert within the clean-cut hole.

The insert is driven 1/32" beyond the inside diameter of the tubing. This permits the inside perimeter of the hole through the tubing wall to shrink or contract and lock the insert securely in place.

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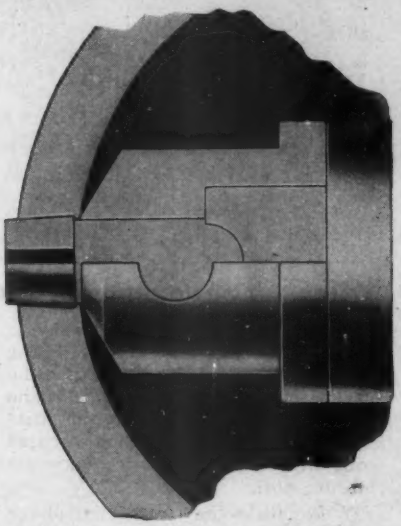

The above quarter section drawing shows insert being thrust through tubing wall. Notice the taper that prevents it from being forced completely through the tubing. The insert is locked so securely in the tubing walls that 5000 p.s.i. differential in either direction across the insert will not force it from its seat or cause it to leak.

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GENERAL PERFORATING PRACTICE

The most common reasons for perforating tubing are as follows:

1. To utilize gas from the annular space to assist flow in the tubing string.
2. To provide gas lift jets without pulling tubing when a well is to be put on gas lift.
3. To make possible circulation above a stuck packer.

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DALLAS, TEXAS

vations have to be made for such an installation the advantages of economy in comparison with other methods may be lost. From a purely mechanical standpoint the method is less efficient than use of roller rod-line carriers. Attention has been called to the fact[1] that in catenary sags the reduction of friction takes place mainly during the upstroke part of the cycle. On the downstroke the friction loss is high which has unfavorable effect on the counterbalancing function of the well in regard to the opposing well.

In a properly constructed catenary sag rod-line installation the rod lines barely touch the doll heads during the upstroke of the pumping jack. There is also no tendency of rod lines to jump from the bottoms of sags. To simplify the calculations involved the parabolic formula is used, which approaches the catenary very closely when the sag is less than 10 per cent of the span.[2] This formula, for points of support of equal elevation, can be written as follows (Fig. 1):

$$WX^2 = 2Py \qquad (1)$$

where

W = weight of rod line in lb. per foot
X = half of distance between supports, feet
P = maximum rod-line pull, lb.
y = amount of sag, feet

The maximum rod-line pull P will be discussed later in more detail. At present it is sufficient to say that this rod-line pull consists of peak polished-rod load of the well served by the rod line, plus the rod-line friction plus the rod-line inertia. With the rod-line pull measured or calculated Formula 1 can be used to determine the spacing of holdups, if their height is known, or the allowable sags for given spacing of holdups.

For the case in which the rod-line supports are of different elevations, the problem resolves itself into finding of horizontal distances from bottom of sag to the points of support and the amount of sag itself in relation to one of supports (Fig. 2). The starting point of the solution of the problem is again the basic parabolic formula. From this formula, without going into details of mathematical solution,[3] the distance of the bottom of the sag from the support of the lower elevation can be expressed as follows:

$$X = \frac{L^2 - \frac{2Pa}{W}}{2L} \qquad (2)$$

$$y = \frac{WX^2}{2P} \qquad (3)$$

where

P = rod-line pull, lb.

and meaning of other symbols is shown in Fig. 2.

In many cases the topography is such that the maximum allowable sag cannot be installed. In such a case the sag "y" is a known quantity and the expression "W" represents this part of the weight of rods which is lifted from the doll heads at the maximum rod-line pull.

To illustrate the use of the above formulas in construction of rod-line sags, assume that a catenary sag rod line is to be constructed for following conditions:

Maximum rod-line pull—8,000 lb.
Pull rods—¾-in.—1.69 lb. per ft.

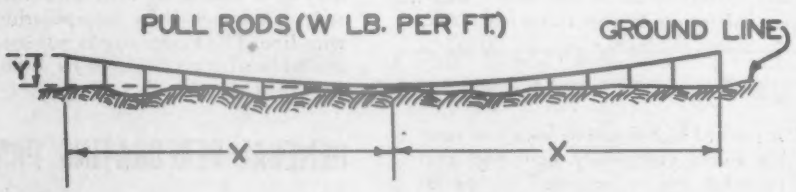

Fig. 1—Exaggerated profile of a catenary sag for supports of equal elevation

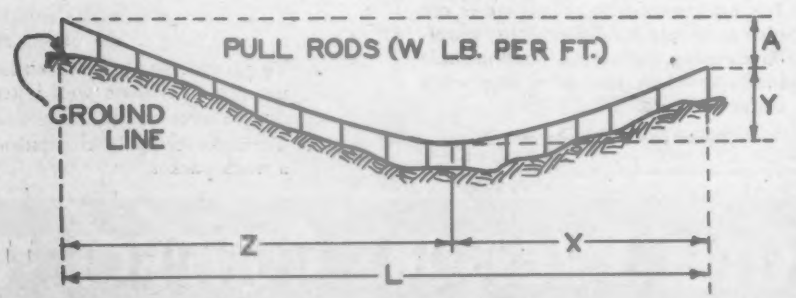

Fig. 2—Exaggerated profile of a catenary sag for supports of unequal elevation

Example 1.—Holdups, 5 ft. high, are used in a flat terrain. The problem is to determine the spacing of the holdups for the correct sag.

From the basic Formula 1 half of the distance between holdups is:

$$X = \sqrt{\frac{2Py}{W}} = \sqrt{\frac{2 \times 8{,}000 \times 5}{1.69}}$$

$$= 218 \text{ ft.}$$

Distance between holdups 2X = 436 ft.

Example 2.—For given conditions assume that there is a difference in elevation between two holdups amounting to 8 ft. The terrain between sags is such that maximum sag is allowed. The holdups are set 600 ft. apart. The problem is to find the amount of sag and the position of the bottom of the sag in relation to the holdups.

Using Formulas 2 and 3 and referring to Fig. 2 the distance of the bottom of sag from one of the holdups is:

$$X = \frac{L^2 - \frac{2Pa}{W}}{2L}$$

$$= \frac{600^2 - \frac{2 \times 8{,}000 \times 8}{1.69}}{2 \times 600} = 237 \text{ ft.}$$

The distance from the bottom of the sag to another holdup:

$$Z = L - X = 600 - 237 = 363 \text{ ft.}$$

The amount of sag:

$$y = \frac{WX^2}{2P} = \frac{1.69 \times 237^2}{2 \times 8{,}000} = 5.9 \text{ ft.}$$

Example 3.—Assume conditions as in Example 2 except that terrain between the holdups is such that there is no room for maximum allowable sag. In such a case the amount of sag, y, is fixed and known. For such a case the distance from one of the holdups can be calculated by the formula:[2,3]

$$X = \frac{L}{a}\left(\sqrt{y\,(y+a)} - y\right) \qquad (4)$$

and the weight W represents this part of weight which is lifted from the doll heads.

For conditions of Example 2 the maximum allowable sag was calculated as 5.9 ft. Suppose that terrain between the holdups permits only the

sag of 3 ft. In such a case from Formula 4:

$$X = \frac{600}{8}(\sqrt{3(3+8)} - 3) = 206 \text{ ft.}$$

From basic Formula 1:

$$W = \frac{2Py}{X^2} = \frac{2 \times 8{,}000 \times 3}{206^2} = 1.13 \text{ lb.}$$

This means that of the total weight of rods of 1.69 lb. per ft., 1.13 lb. per ft. will be lifted and only the difference that is 0.56 lb. per ft. will be left resting on doll heads.

Installation of Sags

In laying out an actual installation of rod-line sags several short-cut methods have been worked out which permit rapid progress of the necessary work. Tables can be worked out for different rod-line pulls showing the allowable sag for different sizes of rods and for different lengths of the sag.[10] In making actual installation the holdups are installed first. A wire is then stretched between the holdups with sufficient tension to produce the sag determined from the tables for given set of conditions. This can be done by sighting between ends of the sag and measuring from the line of sight to the wire with a leveling rod. Once the proper sag of the wire has been determined the pipe supports are driven in the ground, at the desired intervals, to match the curve of the stretched wire. Proper allowance should be made for the doll heads and the allowable sag should not be exceeded for given maximum pull and given size of rod line. To avoid possibility of rod failures due to fatigue at the end of the sags, that is at the point of change in vertical direction, this angle of change should be kept low. Bridges suggests[5] that this angle of change should not exceed 5° for wells weighing around 10,000 lb. and 8° for wells weighing up to 7,000 lb. In determining the angle of bend of rods the sag on both sides of holdup must be considered.

Considerable experimental data are available showing the savings obtained through installation of sags. It has been reported[3] that for properly constructed rod-line sags, in combination with roller carriers, a saving can be expected of from 0.85 to 1.85 hp. per 1,000 ft. of rod in gently rolling terrain and of 2.25 to 2.5 hp. in rough terrain, as compared with conventional straight lines. Installation of even small sags tends to improve the efficiency of the lines.[11]

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Equipment for Reverse Circulation

(Continued from page 123)

generally used for the depth range of the particular wells is sufficient for reverse circulation. A tubing truck or a swabbing unit is satisfactory. generally a double-drum draw works provides a greater flexibility as it eliminates changing lines in case it is desired to swab a well. The hoisting equipment need not have the excess weight-handling capacity of a regular drilling rig as the danger of getting stuck while reverse circulating is very slight. In fact it is very rare that a reverse-circulation job is bothered with a sticking drill stem and when it does occur it generally is due to letting the bit down into an old hole which was not originally drilled to gage.

If no derrick is over the well, some means of handling the blocks and the tubing must be provided. Generally either an A-frame or an open-front portable derrick is used. As not many trips will be made on any one well, pulling the drill stem in singles is satisfactory. A swivel and a rotary hose are also needed.

Pump Capacity

Pumps used with reverse-circulation rigs need not be large as the hole drilled is quite small and sufficient velocity can be obtained through the 2 or 2½-in. tubing with a 5-in. by 8-in. or a 5-in. by 10-in. pump driven by an 85 or a 100-hp. engine. The pump should not be driven by too large an engine as the capacity of the gear box on the pump may be exceeded. If more fluid velocity is required it is better to use a larger pump than to operate a small one at excessive speeds. Operating at 50 s.p.m. a velocity of around 12 ft. per second is obtained through 2-in. tubing with a 5-in. by 8-in. pump or 2½-in. tubing with a 5-in. by 10-in. pump.

The pump, along with its prime mover, is generally mounted on a skid which can be set at a convenient point. Fluid lines to and from the well are often equipped with lengths of rotary hose to provide flexibility in rigging up. The rotary hose between standpipe and swivel needs to be of the high-pressure type, even though it is being used most of the time for a discharge from the eductor, because it is often desired to circulate in the normal manner.

Each of the component parts of the reverse-circulating equipment has been described separately and this is often the way they are seen in the field. Many of the rigs are built around the equipment available through the addition of necessary items.

A highly portable and quickly assembled reverse-circulating rig can be obtained by simply adding a drilling head to one of the several makes of truck-mounted slim-hole rigs which generally include two engines, two pumps and either a single or double-drum hoist with rotary-drive attachment. These rigs have self-raising portable derricks capable of handling either doubles or singles of drill stem. One major company has several such rigs.

No earthen pits for fluid are used; instead a steel tank is employed for a fluid reservoir during the drilling operation. As the viscosity of the oil used for a circulating fluid is quite low, very little settling area is required for the removal of cuttings. This tank, which is generally rectangular, can be set above the level of the discharge from the well as the fluid comes out under pressure and gravity flow is not needed. The tank is generally connected to lease storage and generally a bypass from the standpipe is provided so the well can be flowed into the storage tank if it is desired. Some operators also provide a portable separator so that flow tests can be made at any time during the operation.

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Application of Rotary Rigs for Drilling Hard Formations in Rocky Mountain Area

by Neil Williams

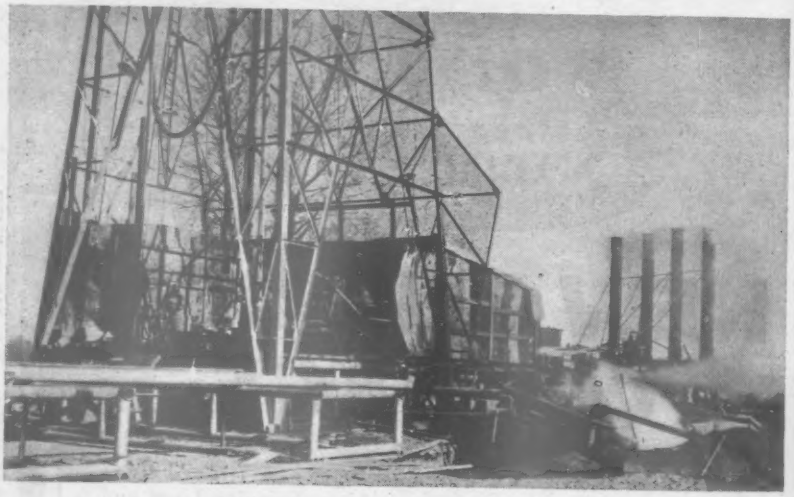
Despite the difficulties of maintaining straight hole in hard, steeply dipping formations and high well costs, general use is being made of rotary equipment in Rocky Mountain drilling. Due to lack of good water supplies, mechanically powered rigs are proving most advantageous.

ALTHOUGH more commonly associated with areas of softer formations, rotary drilling is being employed with satisfactory and advantageous results in the Rocky Mountain region. Despite the very hard and steeply dipping formations and difficulties of maintaining straight holes, application of rotaries in this region has increased to the extent that nearly all drilling below depths of 2,500 to 3,000 ft. is being done by this method. Practically the only places in the Rockies where cable tools still are dominant are in Cutbank, Kevin-Sunburst and other shallow areas of Montana.

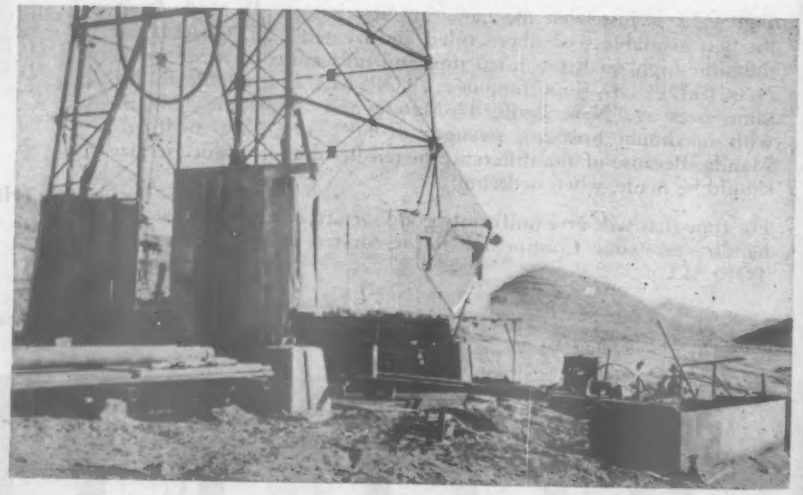
General use of rotary equipment in this district has been largely a development of the past 10 to 12 years. Previously, only a few scattered attempts had been made to drill with rotary tools. Most trials were unsatisfactory. This was due to several reasons, one of which was that tools and equipment available at that time were inferior to those of today in quality of materials and in adaptability to conditions, and were less capable of coping with the wear and abuse imposed by the excessively hard and abrasive formations. Also, it has taken time to develop drilling practices and technique applicable to the particular conditions. Difficulties encountered with crooked holes, twistoffs and other hazards in early rotary attempts resulted in so much lost time and excessive costs that the objectives of rotary drilling often were defeated.

With the improved tools and equipment that have been made available in recent years and the adoption of more effective practices to maintain straighter holes, prevent twistoffs and stuck drill pipe, and combat other problems, rotary drilling in this district has been greatly expedited and costs reduced.[1] These reductions in drilling time and costs in turn have placed rotary rigs in favorable competition with the normally somewhat slower, although often more effective, cable tools.

Most rotary rigs operating in the district employ mechanical power, either internal-combustion engines or electric motors. The majority of these use internal-combustion engines, although there is a fairly large representation of electric rigs. The principal factor in the use of mechanical rigs is the almost general lack of adequate supplies of good water for steam generation. In many places water has to be hauled long distances even for internal-combustion-engine needs. The latter situation has encouraged the use of electric rigs where electric power is available



One of the few steam rigs in the Rocky Mountain region. This rig is in the Garland field, Big Horn County, Wyoming



Wildcat test on Alkali basin structure, Big Horn County, Wyoming, being drilled with "slim-hole" drilling rig

without too much difficulty.

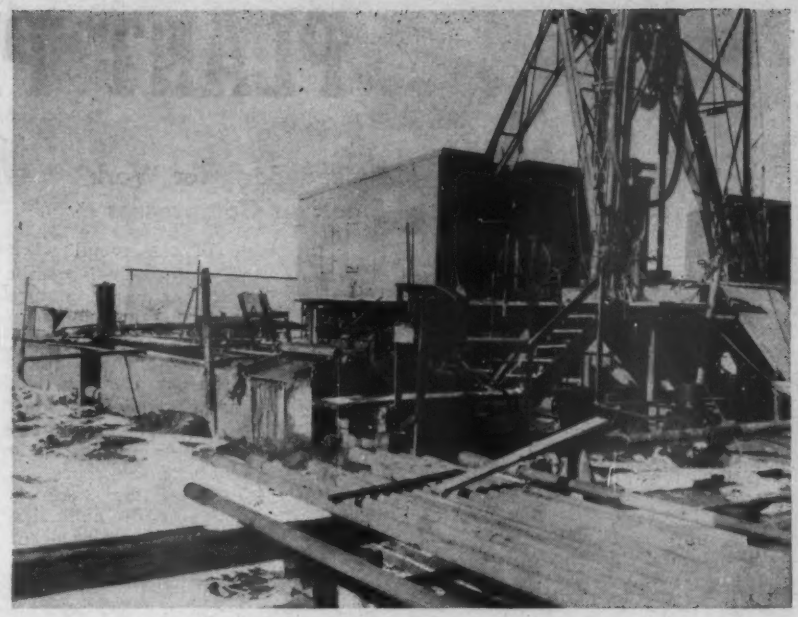
Another factor in the use of mechanical rigs is the fact that many operations in the district are scattered or located in remote places, where transportation is a major item. Mechanical rigs generally are more easily moved and set up than steam rigs. Also, the light and medium-sized equipment being used in the district can be more completely unitized for greater portability.

Steams rigs, however, are being operated to advantage in a number of places where water is available. One place in particular at this time is the Garland-Byron fields of Big Horn County of the Oregon basin, northern Wyoming. Steam rigs are used exclusively in these two adjoining fields with water being obtained from a river which flows through the middle of the fields. It so happens that the water, while usable in the boilers, is not suitable for internal-combustion-engine needs. Another steam unit, the largest rig of any type which has ever operated in the entire district, is now running in the Lance Creek field.

Diesel as well as gas and gasoline engines are employed commonly on mechanical rigs. While diesel and gasoline engines are of particular advantage on wildcat or outlying locations where natural gas is not convenient, many rigs operating within gas-proved areas use diesel oil or gasoline for fuel. Electric rigs are mostly directly powered, taking current from nearby "high lines" or field power systems.

Although many deep wells have been drilled and several big rigs have been operated, general drilling throughout the area has not required large and heavy equipment. Drilling problems, except in a few places, have been largely those associated with increasing bit footage, maintaining straight holes, and reducing drill-pipe wear and twistoffs. Such problems have not placed any particular burdens upon surface facilities, so that generally operators have been able to get along with smaller equipment and less-complex rigs than otherwise would be possible.

With deeper drilling becoming more general, heavier and more complete rigs are being provided. Particular attention is being paid to increasing pump capacity. Few rigs have had more than one mud pump, this usually being a 12 or 14-in. unit. Mud control, however, is becoming an increasingly important technique, and many operators are finding it expedient to provide additional and larger pumps, not only for mixing mud but also for auxiliary-circulating duty. It also is being found that in some cases increased mud volume and pressure, which would not be possible with the single small pump, is a factor in increasing bit footage



One of the more complete and modern diesel-engine rigs with "jack-knife" derrick

Derrick floor of "slim-hole" drilling rig on Wyoming wildcat test showing separate gasoline engine rotary drive

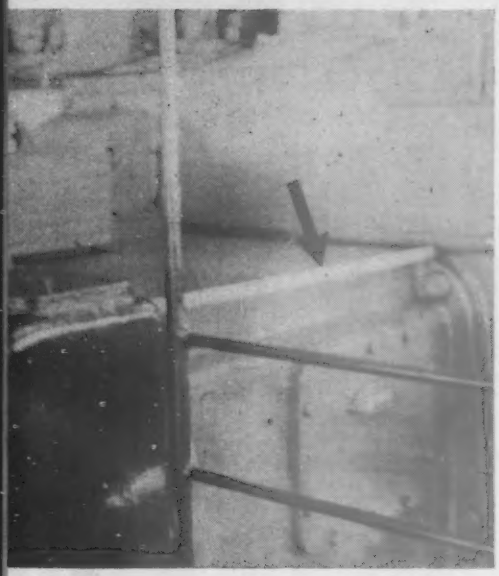
Most of the more modern rigs now have available at least 500-lb. pump pressure as against 250 lb. which was common to most rigs until recently. In the Garland field, one of the few fields in which high gas pressures are encountered, the rigs (steam) have two 20-in. pumps, although this size is unusual in the district.

Comparatively recent additions to rigs in the district are two slim-hole drilling assemblies. These are equipped to drill 6⅝-in. hole below the 8⅝-in. surface casing which is ordinarily run. Both, designed for wildcat work, are equipped with gasoline engines, with a separate engine for the rotary drive. Conventional 126-ft. steel derricks are used on both.

"Jackknife" or other collapsible-type derricks have been employed to advantage with many rigs, facilitating moves. Conventional-type derricks, however, are not being supplanted. These usually are the 126-ft. type with 24-ft. base. There is no definite practice on the use of substructures.

1. Williams, Neil, "Reducing Rotary Drilling Hazards in Rocky Mountain Areas," The Oil and Gas Journal, Dec. 9, 1943, p. 43

PLANT PRACTICES



Raised Edge for Work Floor on Compressor

ON the edge of the metal work floor on the top of the compressor shown in the accompanying picture there originally was no obstruction to prevent an operator's foot from slipping off, an accident which might easily occur if the operator had any grease or oil on the soles of his shoe. To forestall such an accident, the operator welded a piece of 1-in. angle iron along the edge of the floor. The inside of one side of the angle is welded up flush against the underside of the floor, so that the other side of the angle extends up above the floor, providing the obstruction.

Lubricating-Oil Storage and Dispensers

TO eliminate the use of tilting drum racks and the occasional loss of oil due to unavoidable spilling, a California company operating gasoline plants, compressor stations and gas-lift plants has provided facilities for withdrawing the lubricant directly from the drums without transferring to separate containers. The drums in use are the standard shipping containers having the conventional bungs in the head. The company using this device erects a permanent double-deck supporting platform at the end of the engine room, just outside the point where the oil is withdrawn for immediate use in the force-feed lubricators and crankcases of the engines and compressors. The rack is built of pipe welded at all connecting points with the bottom ends of the risers set in concrete for stability. Transverse pieces of planking are laid on the horizontal pipe members, spaced so that a single drum will lie snugly in the desired position before being connected to the dispensing faucets inside engine room.

Piping, with convenient bushings, is attached to the bungs before the drums are rolled to their respective cradles, and afterwards, the lip unions are made up so that oil will flow from the drums, by gravity, to the dispensers. A high-bed truck delivers the filled drums to the location from which each filled container is skidded to the upper platform. When the drums become empty, their weight is such that one man can lift them easily from the cradle to the second platform, or lower one, where they are stored until the delivery truck returns with another load. The faucets are the common type which lift to open when the measuring can is placed beneath by the operator. The drip bench below has a shallow sink to receive occasional drops, and has a compartment below, closed with sliding doors, to store the oil measures when not in use.

Adjustable Pipe Supports

VERY convenient "yoke" supports, to hold piping and other such material when placing or fabricating equipment, may be made by welding three legs of angle iron or rod to the end of the larger of two sections of straight pipe. Near the other end of this pipe a hole is drilled to take a threaded collar, short section of pipe of the required diameter, or smaller piece of metal suitable for its purpose.

This piece is threaded to receive a threaded rod which thus can be screwed forward so its inner end extends into the pipe section to which the feet have been attached. To the outer end of the threaded piece a handle is welded at right angles, or a hand wheel such as is used on small valves may be fitted to permit turning of the set screw thus formed.

A second section of pipe, small enough to slip into the first legged section is fitted at one end with a fork or yoke, of any desired angle or spread. This may be done by splitting the end of the pipe for a distance with a saw or torch and bending the upper ends outward to make the desired angle. Or a piece of rod, small pipe, etc., may be bent to the desired angle and welded at the bend to the top of the smaller pipe section with the V upward. When and if desired, a third section of pipe may be fitted with set screws, making a three-section support which may be extended further than two sections can be extended. Another method is to fit a collar and set screw around the upper, smaller section of pipe, which may be set at any desired point on the upper section, riding on the upper end of the lower, legged section.

Your last chance to name our pumps—

and win a $1000.00 WAR BOND

*SERIES "E" BOND—VALUE AT MATURITY ONCE

WE WANT a name for our pumps so identifying all the features in a word the marked qualities resulting from ment program that has efficient pumps.

Contest closes at midnight MARCH 15, 1944

SEND IN YOUR ENTRY TODAY

Here's the reason for the contest

In 1924 this Company was formed to manufacture the Fluid Packed Pump, a distinctive 3-tube pump with the positive Fluid Seal. Because this pump filled a definite need for meeting varying difficult condi tions, it met ready acceptance. While it is still maunfactured and gives outstanding service in its particular field we have added many other types of pumps, until today we are the world's largest exclu sive Oil Well Pump Manufacturer, and make a pump for every need. Since old names linger in people's minds and oil men are prone to refer to *all* of our pumps as Fluid Packed Pumps, we are taking this means of selecting a new name which will identify our complete line.

A Complete Line of Pumps to Meet Every Operating Condition

Improved Insert — The quality pump equipped with one-piece hardened and honed barrel of heavy wall thickness assures unusually long life and permits several rehone jobs. The most versatile hard metal pump available.

Groove Seal — An economically priced pump providing 4 to 6 times harder barrels than ordinary pumps. Longer production and fewer replacement parts make these hardened and honed one-piece barrel pumps today's outstanding value.

Flucup—A cup and barrel-type pump of improved construction with hardened and polished barrel. Highly satisfactory for "easy to pump" wells and also recommended for wells making high gravity oil with poor lubricating qualities.

Flu-Ring — Combines 36 to 48 composition rings on a plunger body for effective sealing. One of the most efficient types for pumping wells where water volume or lubrication-free fluid is a problem.

Fluid Packed (3-tube)—An all purpose pump especially adapted for troublesome wells. (The "fluid being pumped" acts as a sealing factor.)

Tubing Liner — This standard type pump meets the requirements of volume conditions.

For the 6 best names, the following awards will be made:

1st Prize	$1000.	Series "E" War Bond
2nd Prize	$50.	Series "E" War Bond
3rd Prize	$50.	Series "E" War Bond
4th Prize	$50.	Series "E" War Bond
5th Prize	$50.	Series "E" War Bond
6th Prize	$50.	Series "E" War Bond

CONTEST RULES

All men engaged in production and drilling are eligible (and men in the Armed Forces who were previously engaged in these branches of the oil industry).

Each contestant is limited to one entry.

All entries must be postmarked not later than March 15, 1944.

All entries must be submitted on the attached coupon.

In case of ties the name with the earliest postmark wins.

All entries become the property of Fluid Packed Pump Company and the decision of the judges will be final.

OGJ

OIL WELL PUMPS
906 BENDIX BLDG., LOS ANGELES 15, CALIF.

My entry as a name that best describes your complete line of pumps is

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NAME _____

COMPANY _____

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QUESTIONS on TECHNOLOGY

by W. L. Nelson

Salaries of Refinery Technologists

I would like to know the approximate average monthly rate of pay, based on a 48-hour week, which the refining industry is paying for graduate chemists having 2, 4, 6, 8 and 10 years of refinery experience. The rates of pay are desired for chemists who do not have supervisory responsibilities, but do perform duties which are professional in character—J. J. S.

This is an unfortunate time to consider such a question because of the expanded pay rates existent today, particularly for those young men who are entering the industry from the schools. At the present time, students are entering the petroleum industry at salaries ranging from $150 to $225 per month and those men who have a master's degree are receiving $200 to $275 per month. These are, however, unusual times and hence it is necessary to turn to records of other years—and unfortunately to the depression years.

In a most general way, the salaries of chemists in the Mid-Continent area have been about as follows:

After 2 years	$180-225
After 4 years	205-275
After 6 years	225-320
After 8 years	240-365
After 10 years	250-400

The September 12, 1940, issue of the Questions on Technology page of The Oil and Gas Journal states that the starting salary of young chemists is $125 per month plus about $200 per year extra for each year of service.

Perhaps the best statistical information on this situation is the survey conducted by the American Chemical Society and reported in the November 25, December 10, and December 25, 1942, issues of Chemical and Engineering News under the title "The Economic Status of the Members of the American Chemical Society." According to this reference, the average salary rates of some groups of chemists are shown in Table 1.

The particular group involved in this question, i.e., petroleum chemists who perform purely professional duties with no supervisory duties, is not a well-paid group. Such a group would probably receive more than the analysis and testing group (Col. 4) in Table 1 but not as much as the petroleum and its products group (Col. 3) which presumably includes all chemists and chemical-engineer employes of the petroleum industry.

TABLE 1—AVERAGE MONTHLY SALARY RATES VS. YEARS OF EXPERIENCE

Years after entering profession	(1) All A.C.S. members	(2) A.C.S. chemists (all industries)	(3) Petroleum and its products	(4) Analysis and testing (all industries)	(5) Technical administration (all industries)
2- 3	164	168	182	163	...
4- 5	189	189	200	167	207
7- 9	238	239	247	193	269
10-13	275	275	302	213	328
14-17	323	322	372	235	400
18-21	361	354	426	258	453
27-31	423	407	500	254	570

To adopt an average wage scale from figures such as those shown in Table 1 would be inadequate because there should be some spread in the salary scale to allow for special talents. An indication of this spread is given in Table 2.

Thus, the salaries of a few of the men should be about twice the average and a few men will be so inefficient that they are worth only about two-thirds of the average.

TABLE 2
Monthly Salary Levels of Chemists and Chemical Engineers

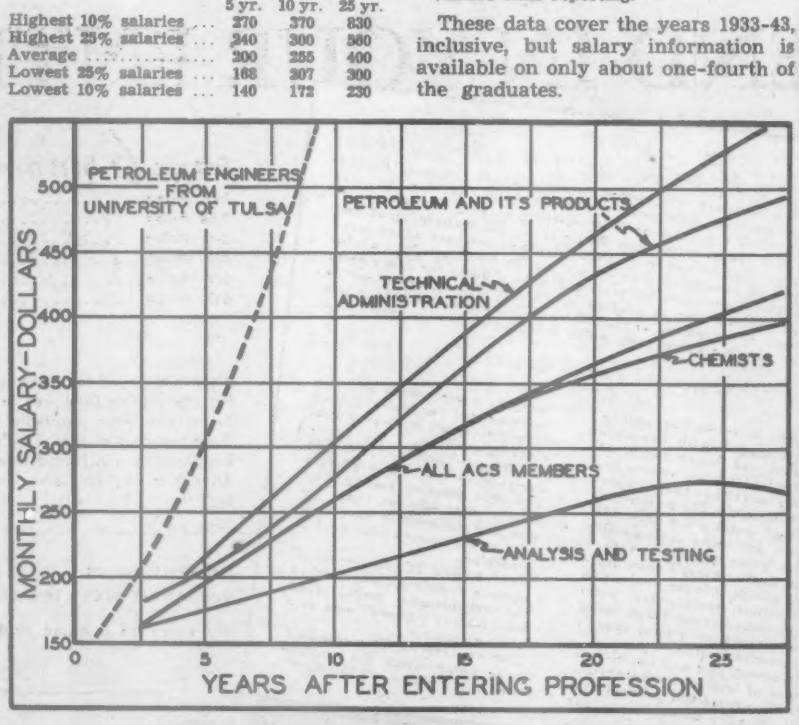
	After 5 yr.	After 10 yr.	After 25 yr.
Highest 10% salaries	270	370	830
Highest 25% salaries	240	300	560
Average	200	255	400
Lowest 25% salaries	168	207	300
Lowest 10% salaries	140	172	230

In the direct experience of this department the above salaries appear to be low. Graduates of the Petroleum Engineering Department of University of Tulsa have received salaries as follows, excluding exceedingly highly paid men from foreign countries:

During:	Monthly salary	Range	Number reporting
First year	$161	100-270	38
Second year	198	*135-300	9
Third year	219	*105-300	12
Fifth year	317	175-500	6
Seventh year	412	210-800	4
Tenth year	583	†450-800	3

*Also three highly paid men.
†Entire class reporting.

These data cover the years 1933-43, inclusive, but salary information is available on only about one-fourth of the graduates.



Salaries of chemists, chemical engineers and refinery technical men. (Mainly from A.C.S. economic study)

OPERATING IDEAS

Gas-Meter Stands

THE metering of gas produced with the oil and liberated in the separator is a practice which is increasing. Formerly gas was metered mainly when it was being sold or delivered to another company or department within a company. Now, it is also metered even though it is vented as by this means an accurate check can be kept on the volume of withdrawals from the reservoir.

The cut shows the meter runs on the vent lines of a pair of separators. This particular field happens to be in the plains country in Texas where cattle are pastured in the fields surrounding the oil wells. The meters must therefore be protected by the fences made from old pipe and sucker rods shown. Similar fences are used around all surface equipment both for its protection and the protection of the animals.

Fuel Header

WHEN drilling boilers are used in the field without unitized skid-type foundations, the sill which is placed beneath the mud ring can also be employed as a fuel header, to save as much piping as possible. The setting for this battery of four oil-field type boilers includes a timber mat laid on leveled-off ground upon which are placed two short risers for each boiler equipped with sheet metal bearing plated. The top of the risers is cut so that the size pipe employed will fit in the saddle without rolling. The pipe may be fitted with flanges at convenient intervals to facilitate rigging up and tearing down. Individual fuel lines from this header support are connected to welded-on nipples which are set into the header as close to the burner and combustion unit as practicable. The fuel-supply line in this setting is laid from the regulator and condensate scrubber along the front of two of the boilers from which point it passes between the second and third unit back to the header support for connection. An emergency shut-off gate is inserted in the supply line in front of the boilers so that the firemen can cut off the gas when and if necessary.

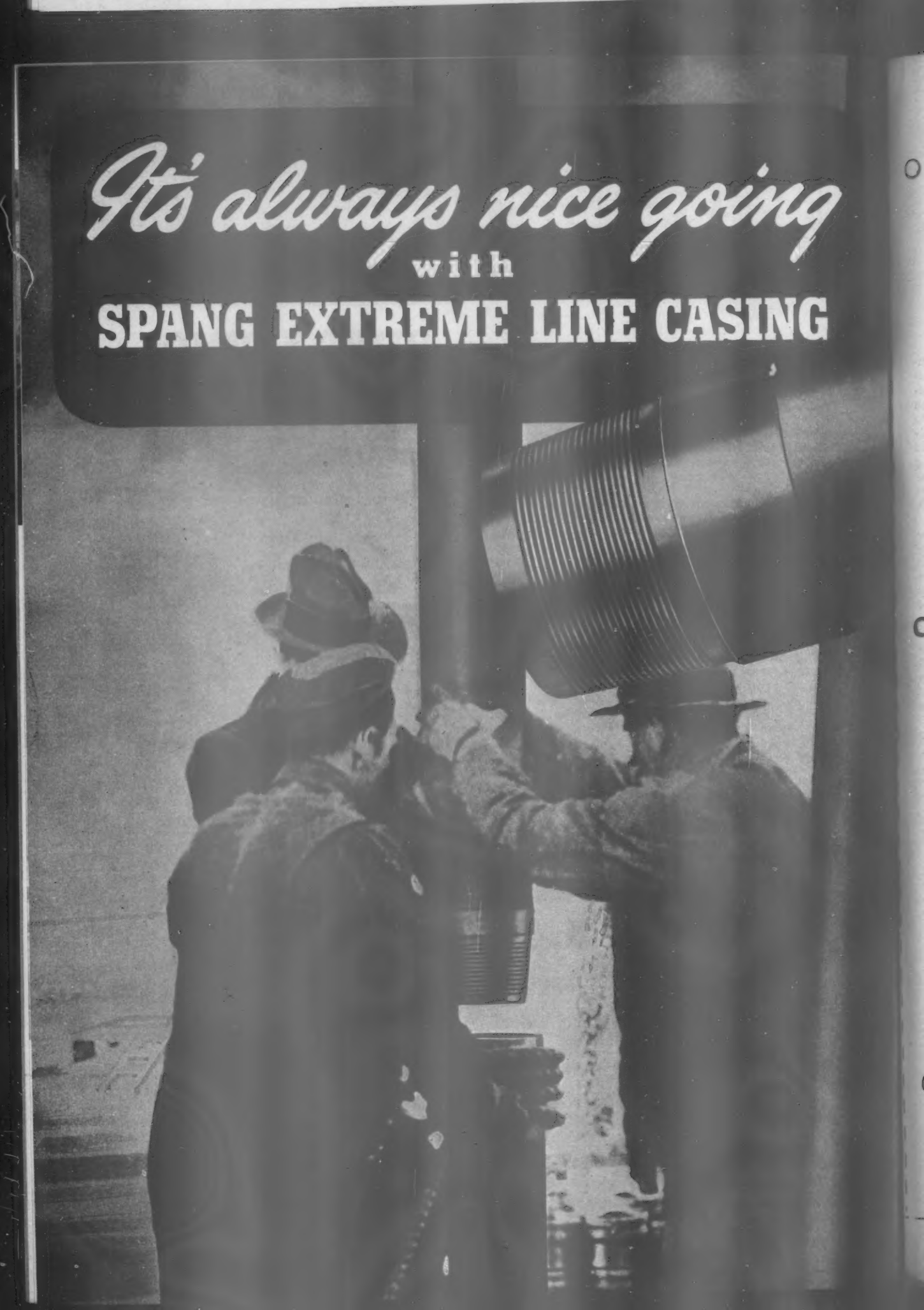
Lines for Spinning Up Pipe

HEMP, sisal and fiber spinning lines are giving way to chains for spinning up pipe. Catlines are now commonly one-third hemp cordage and the remainder wire rope. Only the portion of catline or spinning line which passes over the cathead is hemp cordage. The photograph shows a forked-tail line with chain for spinning up pipe and ⅝-in. wire rope to tong handle. By the time the pipe has been spun up, the slack in the line to the tong handle will have been taken up.

It's always nice going

with

SPANG EXTREME LINE CASING



ECONOMIC FACTORS AFFECTING TUBING REPLACEMENT

TUBING-REPLACEMENT policies have always afforded a major problem to most oil operators. The economic point at which an old tubing string should be replaced with a new one is always a difficult factor to evaluate. This problem is especially pertinent in severe corrosive areas where a considerable number of individual tubing joints are replaced before a complete new string is installed.

Due to wartime restrictions most operators have found it necessary to completely revamp many of their equipment-replacement policies. Tubing in common with other equipment is replaced only when absolutely necessary. In many instances this means that the tubing string is operated past the economic point at which replacement would ordinarily be made.

Most tubing-replacement policies are predicated on the fact that tubing should be replaced whenever the average monthly repair expense becomes greater than the monthly prorated cost of a new installation. Despite the simplicity of this formula, individual well conditions, widespread areas of operation, and difficulties of cost analysis, make any general replacement policy impractical for those operators who may have wells scattered over a number of localities and states. In some areas no corrosion troubles are experienced and failures are occasioned entirely by "rod splits" and thread failures. In many instances, intelligent replacement policies, which are more or less general in scope, can be adopted for these types of wells.

In other localities, however, tubing replacements may be due to corrosive action of the well fluid, and often the repair expense fluctuates widely for wells producing equal amounts of water and oil from the same formation.

Tubing-replacement policies used by most operators in corrosive areas are of three general types—individual joint replacements, sectional replacements, and replacement of the complete string. As a matter of fact, it is usually profitable to make individual tubing-joint replacements until failures occur with regular frequency and repair expense becomes excessive. The locations of the joint failures are then checked and if these have occurred at the same approximate depth, a sectional replacement may be indicated. In any event the tubing is pulled for inspection, and all bad joints or sections are replaced. The tubing is then continued in operation until the complete string is "bad."

In order to prevent excessive down time the complete string may be replaced with new tubing, and the old joints are hauled to the nearest warehouse yard for cleaning, inspection and classification.

A typical analysis of tubing expense is shown graphically in the accompanying figure. In this chart, the average monthly repair expense by quarters is shown for the "years' service" after the original installation date.

This particular well was located in an area where severe corrosion of the inside tubing surface was occasioned by the well fluid. An analysis covering 15 similar wells in the area, indicated that the average cost of a tubing job was $112. In this group of wells the date of the first tubing failure varied from 17 to 29 months after the original date of installation. Considering the entire group of 15 wells, the average service before tubing failures occurred, amounted to 23 months. An estimate covering the cost of a new tubing string is shown in Table 1. This cost of a new tubing string prorated over 24 months of operation, in which little or no repair expense was incurred, amounts to about $100 per month. This would indicate in an approximate way that the old tubing should be replaced whenever the repair expense exceeded $100 per month.

As shown on the chart, the monthly repair expense amounted to less than $100 per month for 44 months of operation. At this time, tubing failures occurred with alarming frequency and the tubing was pulled and laid down for inspection. A 500-ft. section was replaced and no further failures occurred for a period of approximately 6 months. Within a year, however, a number of failures had occurred and the complete string was replaced with new tubing.

TABLE 1—AVERAGE INSTALLATION COST 2,500 FT. OF NEW STEEL TUBING

Cost of tubing	$1,840
Hauling	150
Labor	200
Miscellaneous material	100
Overhead expense	150
Total	$2,440

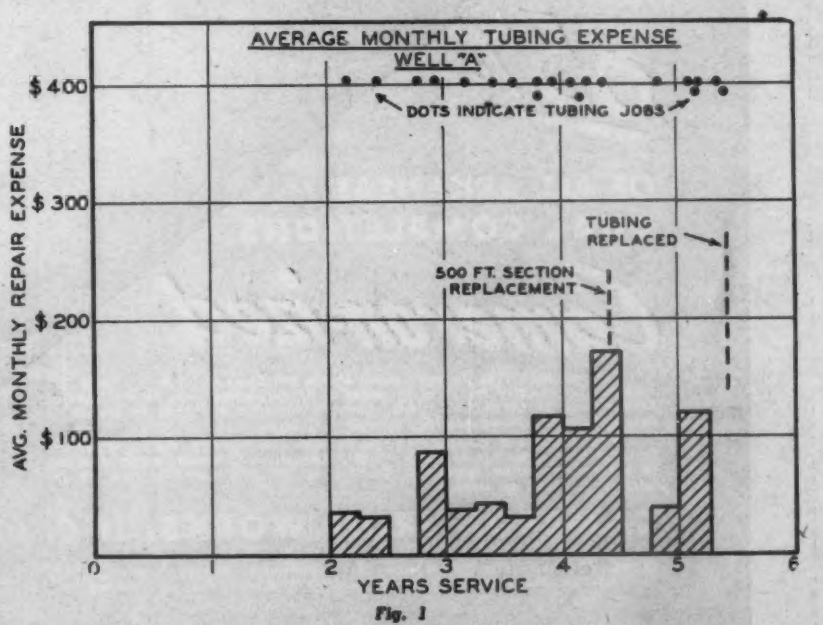


Fig. 1

Dually Completed Arkansas Wells Save Money and Critical Equipment

*by L. L. Jordan and Alec Crowell**

*Engineers, Arkansas Oil and Gas Commission.

MORE than $2,250,000 and 6,700 tons of steel are the initial savings effected by the first 37 dually completed oil and gas wells in Arkansas. These dual completions, as of December 1, 1943, account for an average monthly production of 200,000 bbl. of high-gravity crude oil and condensate and 2,100,000,000 cu. ft. of natural gas. The high-gravity production is used as a diluent for waxy East Texas crude, facilitating the movement and greatly increasing the volume that can be transported by pipe line to the eastern seaboard, while the natural gas, after its sulfur and natural-gasoline content are extracted, moves on in its entirety to war industries and military facilities.

Concurrent production from [illegible] productive zones through [illegible]

tions and orders governing individual oil or gas wells shall be strictly adhered to.

Cost Comparisons

The commission heard evidence at its hearing on May 27, 1942, to the effect that the average cost of the common deep well in Arkansas, including casing, tubing, christmas tree, etc., is approximately $78,100. It was recorded that a single-zone completion to 8,000 ft. would cost $65,600 and one to 9,000 [illegible] would cost $76,700. Thus by du[illegible]letion, a saving of $64,200 [illegible]nt of the cost of the [illegible] be realized.

[illegible]ion was adl necessary wells was [illegible]ile for a was only

at its the ver- om or o

elapsed before the PAW was convinced of the wisdom of the commission's order. The PAW issued its Supplementary Order 9 to PAO 11 on May 22, 1943, which is applicable to the Dorcheat-Macedonia field. Development has gone forward at a rapid rate since that time, the foregoing having been mentioned only in explanation of the retarded development between May 27, 1942, and May 22, 1943.

Thirty-two of these 37 dual completions are in the Dorcheat-Macedonia field of Columbia County. This field, which is under an extensive development program, has already proven a reserve of 90,000,000 bbl. of oil and distillate and over 400,000,000,000 cu. ft. of natural gas. There are 66 producing well bores in the field, 21 of which are located on 1,160 acres and operate as a unit, while two are on 40-acre units and the remaining 43 are in the center of 80-acre units.

The deeper pool—Smackover limestone—which is found at a depth approximately 8,600 to 8,800 ft., subsea, accounts for two-thirds of the reserves mentioned, while the remainder is credited to the upper productive pools—Cotton Valley sandstone—which is found from 6,500 to [illegible]200 ft., subsea.

[illegible]n December 1, 1943, the 66 well [illegible] in the Dorcheat-Macedonia field [illegible]ented 25 single completions in [illegible]mackover limestone, 9 single [illegible]ions in Cotton Valley sand[illegible]nses, 8 dual completions in [illegible]n Valley sandstone lenses, [illegible]ual completions in the [illegible]imestone and Cotton Val[illegible] Thus, 66 holes drilled [illegible]d are getting the pro[illegible] wells.

[illegible]ls in this field are [illegible]ne lenses (Cotton [illegible]rvoir pressures of [illegible] lb. per sq. in. produce water- [illegible] 60°-66° A.P.I. [illegible]o 20,000 cu. ft. [illegible]nses produce [illegible] with ratios barrel. The free from

[illegible] lime)

85%

OF ALL ARKANSAS DUAL COMPLETIONS

Cameron-ized

Cameron Ram Type Tubing Control Heads and Cameron Types "G" and "J" Packers were selected for 31 of the total of 37 dual completions in the State of Arkansas, as of December 1, 1943. Cameron equipped wells now in process of dual completion will substantially increase that figure.

With experience gained from more than two hundred dual completions, Cameron is in a position to make valuable suggestions to operators contemplating multi-zone completion operations. Complete details will gladly be sent to interested operators on request.

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Engineering Fundamentals

No. 123

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL

GEL PROPERTIES OF DRILLING MUD

THE properties of gel strength, gel rate, and thixotropy are closely related to viscosity. A mud possessing these properties will exhibit a relatively high fluidity (low viscosity) when in violent motion, will show greater apparent viscosity at lower rates of flow, and will form a "gel" of still higher apparent viscosity when motion is completely stopped.

Gel strength, as the term itself indicates, is merely a measure after a given period of quiescence of the strength of the gel formed. It is determined by measuring after a given elapsed setting time the stress (force per unit area) required to produce a permanent deformation of the gel. As sometimes used, gel strength refers to the final strength of the gel after the mud fluid has remained motionless long enough for the gel strength to reach a maximum. **Ultimate gel strength** is a more suitable term for designating this property.

Gel rate refers to the time rate of formation of a gel. That is, if the gel forms slowly after the mud is allowed to remain motionless, the gel rate is said to be low; or if the same increase in gel strength occurs in a relatively short time following cessation of motion, the gel rate is said to be high.

A mud exhibiting gel properties is said to be thixotropic or to possess the property of thixotropy. The difference between an ordinary viscous fluid and a thixotropic colloidal suspension (such as a clay drilling fluid) may be illustrated by comparing the properties of strained honey (which is viscous but has no gel strength) with the properties of a thixotropic clay drilling fluid. Small pebbles placed on the surface of the honey in a jar would eventually settle to the bottom of the jar. On the other hand, if some similar pebbles were placed on the surface of the drilling fluid in another jar, they would remain in suspension indefinitely due to the gel strength of the drilling fluid.

The nature of the gel properties of a thixotropic mud may be more clearly understood by referring to the curves of Fig. 1. Curve A is illustrative of a mud having a higher gel rate and a lower ultimate gel strength than the mud represented by curve B. It is noted that in both cases the gel formed rather rapidly at first, finally reaching a constant value (the ultimate gel strength) after a certain elapsed time for each mud.

Elapsed time as plotted in Fig. 1 represents the time that the mud was allowed to remain quiescent after cessation of agitation which produced a completely degelled condition.

Points 1 and 2 on curves A and B respectively represent the 10-minute gel strength of the two muds. In each case the slope of the dotted line drawn to the origin may be considered to be the average gel rate indicated for each of these muds based only on one reading taken after a setting period of 10 minutes. However, the true value of the gel rate at any given time would be the slope of a tangent to the gel strength curve. Thus, it is seen that the gel rate of any mud is a maximum immediately following agitation and becomes zero when the ultimate gel strength is reached.

In general, it is desirable that a drilling mud be thixotropic to a certain degree. This is evident from the fact that during circulation of mud in a hole the carrying capacity of the mud for removing cuttings depends jointly upon its velocity of upward movement and its apparent viscosity. If the mud possessed the same viscous properties as the clarified honey mentioned above (i.e., did not show an increased apparent viscosity at lower flow rates), as soon as the velocity of the upward moving stream of mud was slowed down to less than the velocity of slip of the cuttings in the fluid the cuttings would begin to settle back in the mud column toward the bottom of the hole. Because of the thixotropic property, however, the increase in apparent viscosity at lower circulation rates tends to hinder the settling of cuttings that would otherwise occur. In case of complete stoppage of circulation, the strength of the gel in the mud "freezes the cuttings in their tracks," so to speak, and prevents their settling to the bottom of the hole and causing trouble from stuck drill pipe, inability to reestablish circulation, and other difficulties.

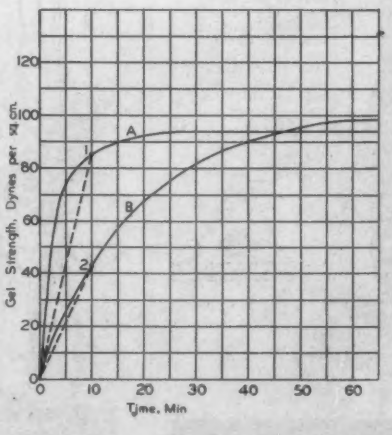

Fig. 1

The gelling properties of a mud may be too pronounced. If the gel rate is too high, sand and cuttings will be entrapped in the mud in the pits before having a chance to settle out. This results in excessive wear of circulating equipment by recirculation of such abrasive material.

Similarly, if the gel rate of the mud is too high gas bubbles may become entrapped in the mud, not being released because the gel forms around them before they can rise to the surface of the mud in the pits. Even air may become entrapped in mud when it drops from the mud ditch to the pits, and will not be released if the gel rate is too high.

If the gel strength of a mud reaches too high a value, it is detrimental because of the excessive pump pressure required to "break the gel" in resuming circulation in the well after a shutdown period. It is possible for a mud to possess such a high gel strength that some part of the circulating equipment may fail before circulation can be reestablished.

A mud which is too thixotropic may channel through the annular space between the drill pipe and the walls of the hole causing dead areas where cuttings collect and possibly freeze the drill pipe or at least require reaming of the hole.

If the gel strength of the mud is too high it may cause a swabbing effect, similar to that already mentioned in connection with a high mud viscosity,* which may lead to a blowout or excessive caving due to lowering of the hydrostatic pressure at the bottom of the hole.

*Installment 120.

Series prepared by Glenn M. Stearns, associate professor of petroleum engineering, University of Oklahoma

Official U. S. Navy Photo

Violent Sea Action!

"Sure Kill" of a Nazi sub is depicted in this remarkable close-up of a U.S. bomber attack against a Nazi wolf pack. One bare-legged Nazi stands in awe as another ducks. Arrow points to depth bomb about to hit water.

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Photo at left shows a set of Garlock CHEVRON packing and a single Chevron ring. Chevron is one of the many Garlock packings being supplied to the U.S. Armed Forces and war industries.

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REFINING

Pacific Oil & Refinery Co. Adding Canadian Facilities

LETHBRIDGE, Alta.—Pacific Oil & Refining Co.'s plant here will be enlarged by construction of four 2,500-bbl. steel storage tanks. An absorption plant is being moved to the field for production of natural gasoline and two additional wells will be drilled in the Del Bonita-Twin River area.

Military Uses Absorb 60 Per Cent of Wax Output

WASHINGTON, D. C.—Petroleum-wax production rose to the all-time peak of about 380,000 tons in 1943, it was disclosed here last week by the

Sketches of Plant Operators

CHARLES MORGAN, superintendent of the Denver, Colo., refinery of Continental Oil Co., had a year of high school behind him when one of those situations that have a way of scrambling human plans forced him to look for a job. He found it in a subsidiary shop of Northern Pacific Railway in Roslyn, Wash., where he spent the next 3 years as an apprentice machinist. World War I came along, and the boy enlisted in the Signal Corps of the U. S. Army. He had been in that unit a short time only when, always seeking something higher, he got into the Balloon Corps. After 18 months in various Army camps he received his discharge.

From 1919 to 1922, the boom days of the Big Muddy oil field in Wyoming, his native state, the young man worked in a clothing store in Glenrock, nearby. Saleswork didn't fascinate him, so he got a job as a boiler fireman at the Glenrock refinery of Mutual Oil Co. He became a stillman the next year, continuing in that position until Mutual was merged with Continental. In 1928 he was made assistant superintendent of Continental's Artesia, N. M., plant. He was promoted to superintendent in 1929, and in February 1943, he was assigned to his present post in Denver.

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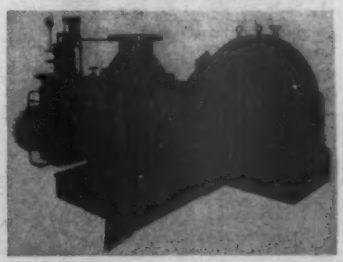

Geared high back pressure unit rated 1300 H.P. at 225 lbs. initial pressure, 500° F. total temperature and 130 lbs. back pressure. Drives generator and is equipped with oil relay governor and back pressure regulator to control electrical load in accordance with steam demands.

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Petroleum Administration for War which explained the vital role this fraction of selected crude oils is playing in the war program.

Sixty per cent of the 1943 production went to packaging field rations for overseas service men, to the manufacture of ordnance wrapping and to "dip coating" ordnance materials. Microcrystalline wax, also derived from petroleum, is used for bomb desensitizing and airplane deicing compounds, and in proofing Army shoes against mustard gas.

Wax content of wax-bearing crudes is only about three-fourths of 1 per cent. So critically scarce are microcrystalline waxes that the 1944 production, which will total approximately 60,000 tons, is being allocated in accordance with the relative importance of the various purposes for which it is intended. Refined and crude scale waxes are not allocated but are short at most refineries.

Manual Issued on How to Unload Hydrofluoric Acid

Manual Sheet H-2, describing recommended methods for handling and discharging steel pressure cylinders containing anhydrous hydrofluoric acid, has been issued by the Manufacturing Chemists Association. This is the third M.C.A. manual to deal with hydrofluoric acid, the other two covering methods of unloading high pressure tank cars containing anhydrous hydrofluoric acid (Manual TC-5) and methods for handling and discharging aqueous hydrofluoric acid from containers (Manual H-1).

The new manual includes a description of the anhydrous acid, general precautions, first-aid treatment, cylinder types, cylinder handling precautions, consumers' equipment, directions for emptying cylinders, operating cylinder valves, and introduction of the acid into process both as a liquid and as a gas. Copies of the manual may be obtained from the M.C.A., 608 Woodward Building, Washington 5, D. C., at 10 cents each.

W.P.R.A. Releases Digest of Petroleum Inspection Laws

The 1944 edition of the Digest of State Inspection Laws Relating to Petroleum Products prepared by the Western Petroleum Refiners Association has been completed, J. C. Day, secretary, announced last week. This brings up-to-date the summary of these laws and supersedes earlier digests.

The digest of gasoline laws is also undergoing revision and will be completed soon, Day states.

Tydal Refinery, Closed by Fire, Resumes Operation

GAINESVILLE, Tex.—The plant of Tydal Refining Co., closed several weeks ago by fire, which caused severe damage, has resumed operation. About $30,000 was spent on repairs and improvements.

District 2 Could Add Much To Refined-Oil Output

WASHINGTON, D. C.—District 2, which includes 14 states, is the area capable of making the greatest addition to the output of oil products, because of its large idle refining capacity, according to E. B. Swanson, economic advisor of Petroleum Administration for War.

It is conservatively estimated that due to the projected decline in crude production within District 2, the idle refining capacity will probably increase to about 300,000 bbl. per day by the last quarter of 1944, unless additional crude oil can be made available to refineries.

Barring an early end to the European war, there is every reason to expect further sharp increases in military demand for petroleum products. Ability to meet these demands without further reducing products available for civilian consumption is highly questionable.

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Gumbo Buster also manufactures two smaller mechanical drilling rigs . . . MC-250, for 5,000' drilling, and TD-150, for 3,000' drilling.

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PIPE LINES

WEP Pumps Products Into 20-in. Line

Pumping of products into the War Emergency Pipelines, Inc., 20-in. system commenced January 25 at Beaumont, Tex., to displace water already in the line for testing purposes. By the beginning of this week the head of the products stream had reached the Fordyce, Ark., pump station, 280 miles from Beaumont. The program for filling the line with products calls for a 125,000-bbl. slug of nonleaded gasoline at the head of the stream which absorbs moisture from the wall of the pipe. This is followed by shipments of No. 2 heating oil. The products stream has been moving at a rate of about 2 miles per hour. On reaching Norris City, Ill., the products stream will be turned into the eastward extension of the 20-in. line to Linden, N. J. Testing operations at certain points in Ohio will be completed before products arrive in that section. No tank-car shipments from Norris City are planned.

Eastern Construction Co. is laying about 18 miles of additional distribution line connected with the Linden, N. J., station. Two pumping units are being added to the Linden station.

Bad weather prevented B & M Construction Co. from laying more than 27 miles of the 51-mile 8-in. feeder line from Lake Charles, La., to Beaumont, Tex., according to reports early this week.

Stanolind Line to Increase Shipments Across Red River

With the completion of installation of three pumping units at the Lakenon, Graford and Bowie pump stations in North Texas, Stanolind Pipe Line Co. this week will increase shipments northward from Texas across the Red River from 64,000 bbl. to 74,000 bbl. daily. Each of the three units consists of a new pump driven by a diesel engine with a rating of 630 hp. at 180 r.p.m.; these engines have been in service on the Stanolind system for some time during which each delivered 450 hp. at the slower speed of 155 r.p.m.

Permission has been granted by War Labor Board to the Stanolind company to pay "going time" one way for construction and maintenance crews employed in routine operations. About 600 workers will be affected by the new provision which means that men will be paid for the time required for transporting them from the warehouse where they check in to the job in the field.

Laying of West Texas Outlets Proceeds Steadily

Construction of outlets from the West Texas field is proceeding at a steady rate which indicates that they will be completed on schedule.

Stanolind Pipe Line Co. has laid more than 200 miles of the 385-mile 16-in. line being built from Slaughter, Tex., to Drumright, Okla. If it had not been for delays caused by bad weather it is believed that 260 miles would have been laid by now. Foundations at stations are ready for equipment. Completion of the project is scheduled for April 1.

Magnolia Pipe Line Co. early this week had 55 miles to lay to complete the 337-mile 12-in. line paralleling its present system from Midland to Corsicana, Tex., which is to be completed before March. Pumping equipment is already installed.

Bechtel-Dempsey-Price Open Lexington, Ky., Office

In preparation for construction of the 259-mile Kentucky section of Tennessee Gas & Transmission Co.'s Texas-West Virginia 24-in. natural-gas pipe line, Bechtel-Dempsey-Price have taken over the eighth floor of the Bank of Commerce Building, Lexington, Ky., for quarters in charge of John T. Foster, office manager.

Construction operations are not expected to start until April. At that time field offices for three spreads may be opened at Glasgow, Mount Sterling and Grayson, Ky. Meanwhile, the contracting organization is waiting for authorization to proceed with the clearing of right-of-way.

Sinclair to Expand Its Southwest Texas System

Sinclair Refining Co. will start early in February to expand its crude-gathering system in Southwest Texas through construction of 36 miles of 6-in. line from its Freer station, in Duval County, to the Washburn pool of La Salle County. The line will consist of 20 miles of new line and 15 miles of salvaged pipe. The system currently is handling 40,000 bbl. of oil daily, and the new line will tap a new reserve for the company.

Lone Star Starts Line From Steward's Mill Area

Construction of a 14½-mile 6-in. line to transmit natural gas from the Stewards Mill, Texas, area in Freestone County to Lone Star Gas Co.'s pipe-line system was started last week with completion scheduled for the middle of February. The line will have a daily capacity of between 11,000,000 and 12,000,000 cu. ft.

From the field, located southeast of Streetman, the new line will extend west and tie into Lone Star's 10-in. line at a point north of Wortham. Construction contracted by Sharman & Allen, is supervised for Lone Star by Julian L. Foster, chief engineer and general superintendent; Luther Tolbert, assistant pipe-line superintendent; Earl Miller, construction foreman, and Lloyd Southard, foreman of the company's Groesbeck pipeline district.

Pipe for the line has been shipped by rail to Richland and Streetman, then trucked to the right-of-way.

Yale's Elk Basin-Billings Project Not Sold to Carter

The Yale Oil Pipe Line Co. project for laying 82 miles of 6-in. and 8-in. line for a system to deliver crude oil from the Elk Basin and Frannie fields on the Wyoming-Montana boundary to refineries at Billings and Laurel, Mont., was not included in the sale of facilities of Yale Oil Corp. to Carter Oil Co. The only pipe line purchased with the Yale production and refineries at Lovell and Worley, Wyo., and Billings, Mont., was the 12-mile system of 6-in. and 8-in. pipe in the Byron-Garland fields, Wyoming.

The Elk Basin-Billings project which has federal authorization for construction is in the hands of a group headed by J. G. Dyer, Midland Savings Building, Denver, Colo.

WMC Regards Welding As Critical Occupation

The job of electric arc welder and high-pressure vessel and piping welder has been added to the list of critical occupations, the War Manpower Commission has announced recently.

WMC pointed out that the only persons included under this title are those who use an electric welding apparatus in welding metal parts in the fabricating, erecting, or repairing of pressure vessels of carbon or alloy steel fabricated in conformance with

codes of the American Society of Mechanical Engineers and the American Petroleum Institute. It does not include welders working on any pressure vessels that do not bear the official stamps of approval of the American Society of Mechanical Engineers.

Added to the essential activities list under Group 14, Finishing of Metal Products, is the activity, "Heat Treating."

Added to the essential occupations in Group 14, Finishing of Metal Products, are the occupational titles: Heat treater, all around; metallurgist; and inspector.

The commission also called attention to a recording of the item, "rubber," in the essential-activities list so that it now reads: "Rubber: Synthetic, natural, chlorinated, scrap, and reclaimed."

PAW Schedules WEP Crude Shipments

February shipments of crude oil through the War Emergency Pipelines, Inc. 24-in. line have been scheduled according to an announcement of PAW. Through the month these shipments will be at the following daily rates although these are not representative of what may be handled on particular days because of the variation in batching of tenders: East Texas crude, 141,000 bbl.; Southwest Texas crude, 54,000 bbl.; West Texas crude, 105,000 bbl. Total daily throughput scheduled is 300,000 bbl. or a total of 8,700,000 bbl. for the month.

Construction Is Resumed On Cities Service Line

After being delayed for several weeks by snow and mud, Bechtel-Dempsey-Price have resumed construction work on Cities Service Transportation & Chemical Co.'s line from Guymon to Blackwell, Okla. Less than 50 miles remains to be laid of this 228-mile 26-in. natural-gas trunk line.

Flow to Be Reversed In 73 Miles of Line

The direction of flow is to be reversed in 73 miles of pipe line in addition to the 3,337 miles of existing lines in which flow has been reversed already in connection with the national pipe-line program. Announcement of this was made by Petroleum Administration for War in a review of what had been accomplished to meet wartime transportation requirements.

A final check of total construction approved by PAW, completed as of December 31, 1943, shows that this work amounted to 7,005 miles, including 4,184 miles of new pipe and 2,821 miles of second-hand pipe. Of that total 3,430 miles of pipe is for the transportation of crude oil and 3,575 miles for carrying refined products.

Including the 436 miles of natural-gas lines converted to oil service, the total amount of pipe-line construction, reversals and conversions authorized is 11,734 miles of which 10,778 miles was completed at the end of 1943.

Shell Transfers Key Pipe-Line Personnel

As a result of the resignation of C. C. Ingram, superintendent of the Mid-Continent area, because of family business interests requiring his attention after the death of a relative, several transfers are being made in the key personnel of Shell Pipe Line Corp., according to an announcement of T. E. Swigart, president. Ingram has been with the company for more than 26 years, in the last 14 of which he has been area superintendent, first in the Texas-Gulf area and later in the Mid-Continent area.

L. F. Young has left the position of Texas-Gulf area superintendent to return to the Mid-Continent area superintendency which he left 2 years ago. C. D. Winkleman, general superintendent, Bayou Pipe Line System has become superintendent of the Texas-Gulf area.

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ECONOMY: Save approximately one-half labor and gas costs.
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The new Pacific Car and Foundry M25 Tank Recovery Unit, consisting of truck and trailer, is an important factor in speeding war action right at the firing line. A 400 horsepower engine . . . complicated transmission system driving axles carrying 900-pound wheels . . . . ability to transport a General Sherman tank at top speed of 30 m. p. h. . . . . these are Tank Recovery Unit features which Spicer engineering and manufacturing facilities have helped make available. In war or in peace, no automotive power transmission job is too big or too small for Spicer. We shall be ready to serve the great automotive industry when production for enormous civilian demands swings into action. Spicer Manufacturing Corporation, Toledo, Ohio.

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Natural Gas

Kansas Natural-Gas Output Makes Big Gain in 1943

TOPEKA, Kans. — Production of natural gas in Kansas totaled 122,089,499,000 cu. ft. in 1943, compared with 98,601,202,000 in 1942, a gain of 23,488,297,000. Daily average output rose from 270,140,000 cu. ft. in 1942 to 334,492,000 in 1943. The biggest gain was in the Hugoton field, where the total was 63,353,908 cu. ft., compared with 41,418,093 in 1942. Declines were recorded in the Cunningham (Viola), Alden, Hollow, Lyons, McLouth, McPherson County, Prusa, Schraeder, Sperling, Wellington, Yoder and miscellaneous Kansas fields. New fields included Cairo (Viola), Krier, Merten, Silica and Whelan.

Production by fields as reported by the Conservation Division of Kansas Corporation Commission follows:

(Thousands of cubic feet)

Field—	1942	1943
Alden	3,265,357	2,116,385
Burrton	3,876,450	6,441,632
Cairo (Viola)	.....	494,135
Cunningham (Viola)	11,001,518	7,772,750
Cunningham (Arbuckle)	1,594,638	1,674,739
Ellsworth	105,200	110,813
Hollow	56,504	29,331
Hugoton	41,418,093	63,353,908
Krier	.....	229,664
Lyons	564,981	399,441
Merten	.....	244,398
McCarty	23,138	30,701
McLouth	4,438,867	2,626,203
McPherson County	1,848,975	1,164,668
Medicine Lodge	9,905,548	13,721,146
Misc. Barton County	216,930	.....
Misc. Cowley County	299,142	260,590
Misc. eastern Kansas*	7,000,000	6,300,000
Orth	494,973	539,313
Otis	11,065,286	13,339,645
Prusa	179,172	38,095
Schraeder	207,142	205,647
Silica	.....	96,803
Sperling	24,001	21,110
Wellington	496,124	310,125
Whelan	.....	78,892
Yoder	519,163	487,365
Total	96,601,202	122,089,499
Daily average	270,140	334,492

*Estimated.

Southern Union Takes Over El Paso's Gas Properties

EL PASO, Tex.—Operation of this city's gas-distribution system has been assumed by Southern Union Gas Co., following approval by Securities and Exchange Commission of that company's acquisition of the properties involved from Lone Star Gas Co.

Southern Union's purchase of the system resulted from the agreement made by Lone Star with SEC for disposal of this part of the company's holdings as a part of the reorganization of the company effected in January 1943.

Engineer Suggests Leakage Tests for Bammel Field

AUSTIN, Tex. — Pressure tests to determine leakage of gas in the Bammel field, Harris County, subject of prolonged controversy, were recommended to Texas Railroad Commission last week by Peter Gregory, petroleum engineer. Field tests, Gregory said, would show whether gas still is leaking into the upper sands of the field, and if so individual wells could be checked to find which was responsible.

Numerous hearings have been held on Bammel field problems, since a well owned by F. M. Corzelius blew out last July. The commission has ordered drilling of a directional well near it.

Natural Gas Shows Marked Gain as Wartime Fuel

WASHINGTON, D. C. — Marketed production of natural gas in 1942 increased 9 per cent over that in 1941, reaching a new high of 3,053,475,000,000 cu. ft. as a result of demand from wartime industries, military encampments and federal housing projects. The output in 1942 was more than twice the volume produced in 1917 and in 1918, first World War years, according to the U. S. Bureau of Mines.

Figures for 1943 are not available, but it is estimated that marketed production increased over 10 per cent.

With the exception of New York, which continued the decline begun in 1939, production increased in the major states. States showing material gains in 1942 over 1941 records were: New Mexico, 21 per cent; Oklahoma, 15 per cent; Louisiana, 11 per cent; and Texas, California and Ohio, 8 per cent each.

Exports to Canada totaled 130,000,000 cu. ft. in 1942, 7 per cent over the 1941 figure. Exports to Mexico totaled 8,572,000,000 cu. ft. in 1942, a 17 per cent gain over both the 1941 figure and the peak of 7,352,000,000 cu. ft. recorded in 1936.

Drilling operations were curtailed by lack of labor and materials. There were 2,597 gas wells reported drilled in 1942 compared with 2,911 in 1941.

Natural Gasoline

Panhandle Production Nearly 35,000 Bbl. Daily

AMARILLO, Tex. — Production of 34,665 bbl. daily of natural gasoline and allied products was reported here this week by the Texas Railroad Commission. Natural gasoline accounted for 28,699 bbl. of the daily output while butane and butane-propane mixtures combined averaged 5,966 bbl. daily.

Current rates of production are approximately 6,000 bbl. daily above the level prevailing during the middle of 1943, indicating the results of liberalized proration allowables in the Panhandle oil fields. Shamrock Oil & Gas Co.'s McKee plant, near Sunray, Tex., is the largest single producer of butane-propane hydrocarbons in the Panhandle. During December, Shamrock's plant produced 2,137 bbl. daily of the district total.

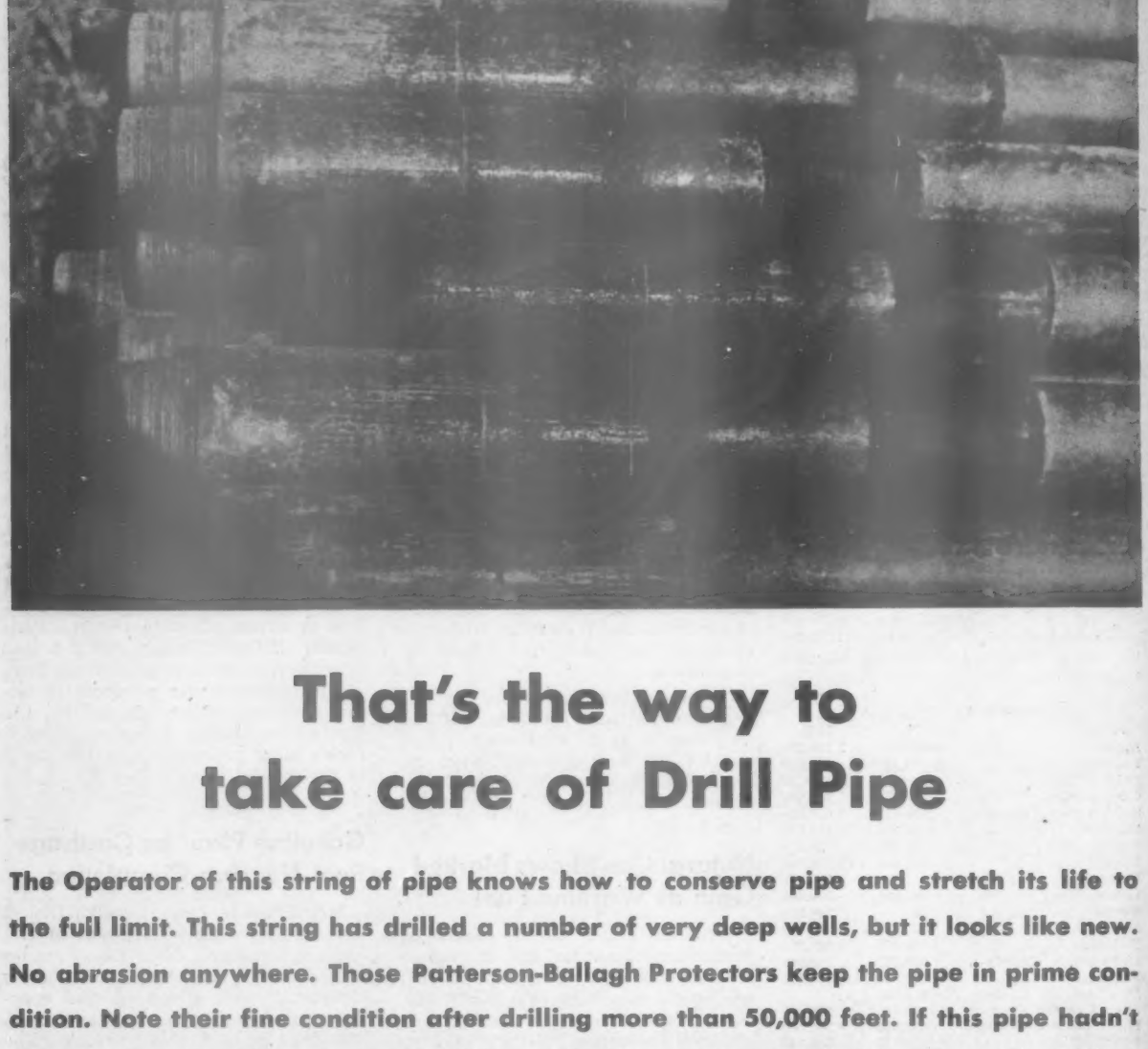
Gasoline Plant for Carthage Pool Nearing Completion

MARSHALL, Tex.—Construction of the gasoline absorption plant of Arkansas Louisiana Gas Co. 9 miles northeast of Carthage, in Panola County, is well advanced, and operators are reported to be planning to start test runs in about 60 days. The plant will be served by gas from deep wells in the Carthage gas pool.

Arkansas Louisiana is nearing completion of a 16-in. gas pipe line to the plant from the Bethany area on the Texas and Louisiana border.

Mountain Fuel Supply Considering New Plant

DENVER, Colo.—Mountain Fuel Supply Co., which produces gas in southwestern Wyoming, northwestern Colorado and northeastern Utah fields and transports it to Salt Lake City and other Utah cities, is reported having plans and specifications drawn for a new gasoline plant to be constructed near the junction where the Hiawatha, Powder Wash and Clay Basin lines intersect the main line into Utah.



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The Operator of this string of pipe knows how to conserve pipe and stretch its life to the full limit. This string has drilled a number of very deep wells, but it looks like new. No abrasion anywhere. Those Patterson-Ballagh Protectors keep the pipe in prime condition. Note their fine condition after drilling more than 50,000 feet. If this pipe hadn't been equipped with Protectors, its life would be just about ended in the tough drilling area in which it was used. Be sure *all* joints are protected with protectors of *full* diameter, the Patterson-Ballagh kind.

The only Protectors equipped with lips
Made of PBX Artificial Rubber—astonishingly tough, durable, and oil resisting

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Exploration and Drilling

Week's Highlights

ANOTHER link was added this week in the chain of shallow fields around the western and southern rims of the Big Horn basin in Wyoming which are being proven productive from lower pays in the Permian and Mississippian. First well to be drilled below the Sundance at Steamboat Butte, last year's outstanding new discovery in Fremont County, Wyoming, shows all earmarks of producing from Embar in the Permian. Before making final test, however, operators are carrying the well into the Tensleep which has gained more prominence as a deeper pay in the current program of deeper exploration in the Rocky Mountains than has been generally credited to the Embar.

Immediately northeast of the Steamboat Butte field is Oregon Basin which produced originally from the Frontier sand in the Cretaceous, but last year was proven productive in the Madison lime and received substantial extensions in the Embar.

Recent and current developments in the Rocky Mountain area, particularly northern Wyoming and southern Montana, show the region to have productive rocks in the Cretaceous, Permian, Pennsylvanian and Mississippian. This diversity of producing formations and the growing regularity with which they are found to contain commercial petroleum deposits around the rim of the Big Horn basin. Of course, none of the more recent discoveries have indicated rivalry of the Tensleep reserves developed last year in the Elk Basin field.

Considering, however, that most of the Embar production was discovered after 1943 was well advanced, and that this pay along with Tensleep and Madison are just now reaching full stature as producing zones in the Rocky Mountain area emphasis rests heavily on future prospects.

The regularity of deep discoveries in West Texas continued unbroken last week with another Ellenburger producer indicated in northern Pecos County. The new pool opener in West Texas is on the south flank of the Ellenburger ridge which runs across northern Pecos County. Previous Pecos County Ellenburger production is higher on the ridge or on the north flank and the latest discovery appears to open more territory to development.

Solid line charts current weekly completions

COMPLETIONS IN ALL FIELDS . . .

(Week ended January 28, 1944)

	Oil	Gas	Dry	Total	Footage	Total Comp. to date 1944	1943
N. Y., Penna., W. Va.	37	18	6	61	119,713	231	227
Ohio	0	12	6	18	46,156	66	54
Indiana	3	0	10	13	24,732	27	13
Kentucky	9	0	1	10	24,096	51	8
Illinois	25	0	10	35	91,876	127	135
Michigan	3	1	5	9	23,994	37	31
Kansas	22	2	21	45	141,810	136	100
Nebraska	0	0	1	1	1,970	5	3
Missouri-Iowa	0	0	0	0	0	3	0
Oklahoma	11	5	14	30	112,043	94	89
Texas:							
North Central Texas	10	0	11	21	57,238	76	94
West Texas	16	0	1	17	66,759	104	65
Texas Panhandle	2	0	1	3	12,289	9	17
Eastern Texas	0	0	0	0	0	25	20
Texas Gulf Coast	3	0	4	7	52,420	29	33
Southwest Texas	6	2	5	13	58,920	69	69
Total Texas	37	2	22	61	247,627	312	298
North Louisiana	0	0	2	2	11,464	19	23
Louisiana Gulf Coast	4	0	1	5	40,120	25	32
Total Louisiana	4	0	3	7	51,584	44	55
Arkansas	2	0	3	5	27,141	14	12
Mississippi and Southeast	0	0	2	2	8,756	13	1
Montana	1	0	0	1	1,851	14	18
Wyoming	2	0	1	3	18,978	10	16
Colorado, Utah	0	0	1	1	4,861	2	1
New Mexico	1	0	0	1	4,328	23	17
California	32	1	8	41	134,757	137	70
Total United States	189	41	114	344	1,086,273	1,346	1,148
Total previous week	187	36	101	324			
Week ending Jan. 30, 1943	160	30	91	281			

EASTERN TEXAS

Smith County Discovery Flowing by Heads

DALLAS, Tex.—Skelly Oil Co. 1 Chisum, Sand Flat area, Smith County, discovery, which indicated producing possibilities from four zones, and which will be dually completed from the two best horizons, perforated opposite Rodessa section at 9,280 to 9,307 ft., treated with 3,000 gal. of acid, and after swabbing for 2 days, started flowing black oil by heads. The well was killed, and casing reperforated from 9,265-87 ft. with 80 shots, treated with 3,000 gal. of acid, and again started flowing black oil and acid water by heads. Skelly has staked an east offset to the discovery.

Panola County.—Continental Oil Co. 1 Burnett Brothers, J. F. Cheairs Survey, Carthage area, has cemented casing for completion in the Cotton Valley section, topped at 8,056 ft. Total depth of the wildcat is 9,309 ft. Two zones indicating production are to be tested. The well is north of gas production from the Pettit.

Marion County.—Test of the Travis Peak will be made by Arkansas-Louisiana Gas Co. at its 1 Walker, J. Humphries Survey, southwest part of Rodessa pool, which was completed several years ago as a wet gasser from the upper Rodessa pay at 5,970 ft. the well will be deepened to 7,300 ft., testing the Pettit and Travis Peak zones.

Morris County.—Failure in the Smackover was indicated at Humble Oil & Refining Co. 1 Wright, Story Survey, which was drilling below 11,729 ft. in dry Smackover lime topped at 11,488 ft.

CALIFORNIA

Midway-Sunset Field Extended ¼ Mile Southwest

LOS ANGELES, Calif.—Chanslor-Canfield Midway Oil Co. has extended the southwestern limits of the Midway-Sunset field ¼ mile by completing a semiwildcat in 2-32s-22e pumping 100 bbl. daily from 2,673 ft.

Standard Oil Co. of California is proceeding with work on a projected deep test to be drilled in conjunction wtih Ethel D Co. in 36-12n-24w. Deep drilling in the Midway-Sunset field will be watched with interest because discovery of Miocene oil sand would greatly increase future recovery. A deep dry hole was drilled in the Buena Vista Hills section several years ago and its failure surprised the entire industry as one or both of the anticlines in the Buena Vista Hills were expected to produce from the Stevens or Vedder zones of Miocene age.

In the Jacalitos district of Fresno County, Standard of California is preparing to make formation test of showings in the top of the Cretaceous at 5,100 ft. in 17-21s-15e. In the Polvadero district between the Coalinga Nose and Kettleman North Dome field, Standard of California's deep prospect tested wet. This well, 1-A Bordieu, in 1-21s-16e, is bottomed at 10,348 ft. with 7-in. pipe at 10,320 ft. Work is proceeding on a test of another interval, the last tested being at 10,312 ft.

Superior Oil Co. has officially confirmed discovery of a new gas field in the Hamilton district, Glenn County, where the company completed 1 Knight, 3-21n-1w, flowing dry gas at a daily rate of 5,040,000 cu. ft.

The final barrier to Seaboard Oil Co.'s proposal to drill a Miocene test at the edge of Elysian Park in Los Angeles was cleared away a few days ago when an injunction to prohibit drilling operations was denied. Seaboard subsequently made location for the wildcat near Bard and Landa streets. This deep test will be bottomed beneath the Elysian Park structure by directional drilling.

Another Arizona wildcat.—Union Oil Co. and Continental Oil Co. spudded a wildcat in the Holbrook area, Navajo County, Arizona, at 1 New Mexico-Arizona Land Co., SW SW NE 34-15n-19e, and will test the Devonian at 4,000 ft. Location is 10 miles southeast of a wildcat recently drilled by the same interests in which the hole was lost at 3,850 ft.

WILDCAT COMPLETIONS

Ant Hills district, Kern County: Amerada 2-15 S.P., 15-29s-29e, dry in basement rocks, TD 4,387 ft.

East Whittier district, Los Angeles County: C.C.M.O. Co. 1-1 East Whittier Comm., 34-2s-11w, dry in barren gray sand, Meyer sand, Pliocene, logged at 5,300 ft.

Hamilton City, Glenn County: Superior 1 Knight, 3-21s-2w, flowed 5,040,000 cu. ft. gas, no oil, 24/64-in. bean, TP 1,075 lb., shut-in pressure 1,480/1,480 lb., TD 6,346 ft., PB 3,690 ft., gun perf. 3,659-64 ft., new gas field.

Orland district, Glenn County: General Petroleum and Union 8-1 Orland Comm., 11-21n-3w, dry, TD 3,223 ft., test 1,825-72 ft., recovered mud and salt water.

Riverdale district, Fresno County: Amerada 55-36 Furtado, 36-17s-19e, dry, TD 8,185 ft.

Tranquility district, Fresno County: Shell 73-35 S.P., 35-15s-15e, dry, TD 8,100 ft., form. test 8,055-8,100 ft. and 4,200-4,325 ft. recovered mud and salt water.

DAILY AVERAGE PRODUCTION FOR WEEK

	Jan. 29 crude oil	Distillate, allied products	Jan. PAW quota all oils	Jan. 22 crude oil
Arkansas	78,300	4,800	81,700	78,400
California	795,750	45,500	873,800	799,650
Colorado	7,840	.....	7,000	7,880
Eastern fields	71,320	9,450	83,350	69,150
Illinois	204,710	12,700	227,700	206,850
Indiana	12,650	.....	14,400	12,150
Kansas	266,700	6,200	291,200	281,050
Kentucky	22,460	3,000	29,000	23,550
Louisiana	357,700	32,000	375,700	358,500
North Louisiana	76,800	.....	.....	77,500
Louisiana Gulf	280,900	.....	.....	281,000
Michigan	52,900	200	56,200	51,600
Mississippi	44,400	.....	48,000	45,700
Montana	25,700	300	23,800	24,330
Nebraska	1,500	.....	1,300	1,300
New Mexico	113,120	6,000	116,600	112,875
Oklahoma	328,800	28,000	356,000	329,800
Texas	1,900,075	126,000	2,018,000	1,900,350
East Texas	336,175	.....	.....	366,150
West Texas	364,675	.....	.....	364,700
North Central Texas	140,400	.....	.....	140,475
East Central Texas	116,500	.....	.....	116,525
Texas Panhandle	98,150	.....	.....	98,100
Texas Gulf Coast	714,500	.....	.....	714,800
Southwest Texas	99,675	.....	.....	99,600
Wyoming	90,600	3,400	103,400	88,220
Total United States	4,394,525	277,550	4,707,150	4,391,355

Total production, January 1-January 29, 1944 ..... 127,045,425 bbl.
Same period last year ..... 111,660,105 bbl.

MISSISSIPPI

Cranfield Extension Test Indicates Big Producer

JACKSON, Miss.—Interest in Mississippi development was heightened considerably by The California Co. 2 National Gasoline Co., Inc., 53-7n-1w, an extension test in the Cranfield area of Adams County. Indicated production is from a deep sand near 10,400 ft., a zone which had given promise in an earlier well. The well was drilled to 10,469 ft., 7-in. casing was set to 10,463 ft. and pipe was perforated with 36 shots at 10,406-18 ft. After squeezing off these perforations, new holes were shot in the pipe at 10,343 to 10,400 ft., and the well de-

veloped a flow of about 25 bbl. per hour through ¼-in. choke against tubing pressure of 1,775 lb. It also showed about 1,500,000 cu. ft. of gas with the 42-gravity oil.

Two other important tests, Gulf Refining Co. 1 Morrison in Jasper County, and Humble Oil & Refining Co. 1 City Bank Farmers Trust Co., in Wayne County, have indicated major production possibilities in upper sands but are being deepened.

MISSISSIPPI WILDCAT COMPLETIONS

Issaquena County: H. L. Hunt Oil Co. 1 Robt. Shaw et al, 3-13n-9w, dry at 6,021 ft. in shale.

Jeff Davis County: Freeport Sulphur Co. 1 Ed Taylor, Oakvale dome, 32-6n-19w, dry at 2,735 ft. in salt.

N. CENTRAL TEXAS

Two New Strawn Sand Pools Discovered in Cooke County

WICHITA FALLS, Tex.—Two new pools, both producing from the Strawn sand, have been discovered in Cooke County. Two miles northwest of the Walnut Bend pool, Sinclair Prairie Oil Co. 1 Montgomery, Robert Finley Survey, showed 4,550 ft. of oil and 50 ft of mud on drill-stem test from 5,114-22 ft., then cored from 4,522-37 ft. and recovered 9 ft. of oil sand and 6 ft. of shale. Casing has been cemented at 5,112 ft. in preparation to complete. The new strike is separated from the Walnut Bend pool by two dry holes, one to 5,829 ft. and another to 6,055 ft.

Second strike for the county is Northern Ordnance, Inc. 1 Foy Davis, G. de los Santos Coy Survey, 1 mile east of Woodbine. This wildcat had saturated Strawn sand pay at 4,340-57 ft., and a 10-minute drill-stem test showed 630 ft. of free oil. Seven-inch casing has been cemented at 4,348 ft.

Montague County—The Hildreth and Turner pools have been linked by completion of Continental Oil Co. 1 Hamilton, Section 57, ET Ry. Survey, which flowed 96 bbl. in 24 hours from Bend conglomerate pay at 6,212-24 ft. after acid treatment of 500 gal. This new well is ½ mile northeast of Gant 1 Turner, Turner pool discovery, and a like distance southwest of nearest producer in the Hildreth pool. Subsurface work shows both of these pools to be on the same structure, with a saddle between. Continental Oil 1 Coffield extended the Hildreth pool ¼ mile west when it flowed 143.52 bbl. in 6 hours through ½-in. choke, and C. H. Murdick 1 Walthall, Section 51, ET Ry. Survey, indicated a further west extension when it showed oil from conglomerate pay in a core from 6,060-76 ft.

Completion on the new discovery 13 miles east of Nocona, The Texas Co. 1 Cobb, showed pumping gage of 41.68 bbl. in 24 hours, total depth 3,394 ft.

NORTH TEXAS WILDCAT COMPLETIONS

Archer County: Akin & Dimock 1 Helen Harmel Perryman, 1,413 ft. from N, 300 ft. from E, Blk. 16, Harris subd., dry, TD 1,531 ft.

M. W. Blair Oil Co. 1 S. L. Scott, 60 ft. from S & E 160-ac. tract, Thos. McCoy Sur., dry at 1,200 ft.

Cochran & Cain 1 H. Forester, 300 ft. from S & W, Blk. 46, J. W. Harris subd., dry at 1,415 ft.

Frank Wood 1 C. L. Abercrombie, 1,200 ft. from S & W, W. A. Rucker Sur., dry at 1,500 ft.

Montague County: The Texas Co. 1 L. L. Cobb, 330 ft. from S & E, C. A. Barnes Sur., 13 mi. E Nocona, pumped 41 bbl., pay 2,213-18 ft., PB to 2,446 ft. from TD 3,394 ft. Discovery.

Wichita County: Geo. W. Graham 1 J. D. Cooper, 540 ft. from N, 1,650 ft. from E, Blk 3, Henry Hastie Sur., dry at 1,328 ft.

WEST CENTRAL TEXAS

ABILENE, Tex.—Hunter & Hunter 1 J. B. Hughes, M. Travieso Survey, 5 miles northeast of Strand pool and the same distance east of Pardue pool, and 11 miles southeast of Haskell, last week promised to open another Palo Pinto lime field pool when it drilled 12 ft. of lime showing oil from 3,278-90 ft. This wildcat had the Palo Pinto considerably higher than the same company's 1 Mabel Jean Wood, 1¾ miles northwest,

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which reported Palo Pinto topped at 3,408 ft.

A. J. Rife et al 1 W. H. Belding, Section 1, AB&M Survey, northwest Palo Pinto County, attracted attention when it logged showings of oil in Marble Falls lime at 3,982-99 ft., and at 4,403-07 ft., total depth.

The Royston pool, northeast Fisher County, will receive an Ellenburger test at Condor Petroleum Co. 1 J. J. Steele, Section 210, Block 1, BBB&C Survey, southwest part of the pool, which will be deepened from its present depth of about 3,200 ft. to Ellenbnrger, expected at about 6,100 ft.

WEST CENTRAL TEXAS WILDCAT COMPLETIONS

Coleman County: Hunter & Hunter 1 Taylor est., 990 ft. from S, 330 ft. from W, Sec. 282, H&GN Sur., 1 mi. W Coleman, Caddo 2,876 ft., SSO 2,642-53 ft., dry at 3,101 ft.

Stephens County: Woodley Pet. 1 F. Thorpe et al, 800 ft. from S & E, Sec. 453, SPRR Sur., north of Leeray, elev. 1,452 ft., dry at 3,366 ft.

Throckmorton County: Grisham Hunter Corp. 1-C R. W. Kelley est., Joe LaBlue & P. F. Goff Sur., dry at 800 ft.

Grisham-Hunter Corp. 1-D R. W. Kelley est., Brooks & Burleson-Joe LaBlue Sur., dry at 800 ft.

LOUISIANA GULF

Wildcat Development Is Slow During Week

NEW ORLEANS, La.—No important new reserves was reported from Louisiana Gulf Coast last week but several operations are near the testing stage. Humble Oil & Refining Co. 1 Federal, 1-11s-13e, at Laurel Ridge Iberville Parish, was drilling deeper below 11,330 ft. in shale after setting 7⅝-in. casing to around 10,890 ft. Humble 1 Virginia Prince, 25-6s-6e, at Krotz Springs, in St. Landry Parish, had drilled plug in the casing preparatory to testing at a total depth of 10,210 ft. Continental Oil Co. and Humble 4 Pardee, north-extension test at Reddell, Evangeline Parish, drilled below 10,920 ft. in the Wilcox after failing to show for production in the Haas sand and possibly carrying salt water in the discovery Tate sand of the Sparta.

LOUISIANA GULF COAST WILDCAT COMPLETIONS

Iberia Parish: Phillips Petroleum Co. 1 A. M. Stewart, Grand Marais area, 2½ mi. SW of New Iberia field, 42-12s-7e, dry at 12,503 ft.

Union Oil Co. of California completed the 8-A Vermilion Parish School Board, 16-15s-1e, East White Lake field, in the 10,500-ft. deep sand, flowing 243 bbl. per day on ⅛-in. choke.

The Texas Co. and Humble added an excellent producer in the west-flank Wilcox area at Pine Prairie, Evangeline Parish, in the 1 Stewart-Ledanois, 35-3s-1w. Pipe was perforated with 192 shots at 10,222-70 ft., 56 at 10,276-90 ft., 296 at 10,322-96 ft., 104 at 10,404-30 ft. and 120 at 10,444-74 ft., and it flowed a potential of 331 bbl. daily on 12/64-in. choke.

SOUTHWEST TEXAS

Shallow Discovery Well Makes 120 Bbl. of Oil

CORPUS CHRISTI, Tex.—Development last week indicated fewer prospective discoveries than in previous recent weeks.

Charles E. Fraser, Inc. 1-447 A. M. Bruni estate, wildcat discovery some 6 miles south of Bruni in Webb County, was retesting, but gage was unavailable. It had made about 120 bbl. daily through open 2-in. tubing from perforations at 1,810-12 ft., on earlier test, with excessive gas and a little water. Cole sand was topped at 1,793 ft., gas in top part, oil in bottom part, total depth 1,812 ft.

Northern Ordnance Co. was preparing to make production tests in the Wilcox horizon in 1 W. F. Heath, a wildcat in Eben Haven Survey, 1 mile north of Mission Valley in Victoria County, at a total depth of 10,000 ft. Casing is set at 9,950 ft. It is expected to make at least a gas-condensate well, but is credited with a number of shows from 4,500 ft. down to about 9,900 ft.

A deeper pay sand is indicated just south of the Alfred field, Jim Wells County, at Humble Oil & Refining Co. 1-C San Antonio Land Bank, which recovered 650 ft. of 42.5-gravity oil, no water, on drill-stem test at 4,950-54 ft., using ⅛-in. top and bottom chokes. Sand and shale carrying an oil show was logged at 4,948-54 ft., about 250 ft. below the regular 4,700-ft. Alfred field pay level. The test was cored below 5,030 ft. and will be carried to 5,500 ft. before attempting completion.

LOWER GULF COAST WILDCAT COMPLETIONS

Bee County: H. B. Zachry Co. 1 Phil L. Campbell, Ray Wilcox discovery, 3 mi. E of Mineral townsite, on N edge of old shallow Ray field, Brooks & Burleson Sur. 1, A-129; top sand 7,569 ft., TD 7,787 ft., 5½-in. 7,787 ft., perf. 120 shots 7,581-96 ft., PT 42 bbl. day ⅛-in. choke or 14,000,000 cu. ft. gas on open flow, est. 20 bbl. cond. per 1,000,000 cu. ft. gas.

San Patricio County: Continental 1 H. W. McNeil, SE Sec. 31, Cubage & Miller subd., 5 mi. NE of Odem field, dry at 7,025 ft.

SOUTH TEXAS WILDCAT COMPLETIONS

Brooks County: Standard Oil Co. of Texas 1 Justo Chavana et al, in La Encantada grant, 3½ mi. SE of Alta Mesa, dry at 7,361 ft.

Jim Hogg County: The Texas Co. 3 Royal R. Yaeger, discovery gas well in R. Garza Sur. 222, A-123, 9,000 ft. NW of Armstrong field discovery well, gas sand 2,869-81 ft., TD 3,468 ft., 5½-in. 2,930 ft., perf. 12 shots 2,878-81 ft., est. 6,400,000 cu. ft. gas on 2-in. tubing.

Duval County: Continental Oil Co. 1 J. F. Welder heirs, J. Poitevent Sur. 211, about 2 mi. SW of Seven Sisters field, San Ignacio area, dry at 3,235 ft.

Live Oak County: Continental 1 Somerset Land & Cattle Co., discovery well in TTRR Sur. 319, 7 mi. NE of Clegg, top Wilcox sand 8,144 ft., TD 8,547 ft., 7-in. at 8,144 ft., PB to 8,193 ft., completed 1-15-44 in open hole 8,144-93 ft., PT 69 bbl. day, ¼-in. bottom and ¼-in. top chokes, 1,600,000 cu. ft. gas, 2-in. set at 8,035 ft. on packer.

SOUTH CENTRAL TEXAS WILDCAT COMPLETIONS

Gonzales County: South Basin Oil Co. 1 Frank Duderstadt, John L. Wood Sur., 3¾ mi. SW of Sample, dry at 5,260 ft.

Guadalupe County: A. J. Hollifield 1 Max Webb, Benjamin Fugua Sur., 2 mi. SW of Luling, dry at 2,824 ft. in Del Rio.

ILLINOIS

Pure Has Large Well In Schnell Pool

CENTRALIA, Ill.—Thirty-five wells were completed in Illinois fields last week, 25 of which were productive. The initial output of 4,139 bbl., averaging 166 bbl. per day per well, was higher than in any week in 1943, during which the initial production ranged from 84 bbl. to 158 bbl. per well.

The Pure Oil Co. completed two of the three largest producers of the week. Pure 1 W. W. Long A, C SW NE 30-3n-9e, in the Schnell pool in Richland County, flowed 977 bbl. in 24 hours through tubing after an acid treatment in McClosky lime at 2,987-92, 2,996-99 (dolomite) and 3,022-08 ft. (no showing). Total depth, 3,075 ft. Pure 2 J. O. Van Fossan A, C SW SW 14-1n-8e, Clay City field, Wayne County, pumped and flowed 845 bbl. initially from Rosiclare lime at 3,027-30 ft. and McClosky lime at 3,043-52, 3,055-57 and 3,108-15 ft. Total depth, 3,120 ft. The well was twice acidized.

Great Lakes Carbon Co. 5 V. G. and W. L. Miller, NE NW NE 28-6s-10e, Concord pool, White County, pumped 456 bbl. from Tar Spring sand at 2,269-75 ft.; total depth 2,279 ft.

One wildcat found oil and five were dry. The successful one, Felix Jablonski et al 1 Yorndorf, C NW NW 3-1n-9e, Wayne County, pumped 49 bbl. after a 30-qt. shot in Aux Vases sand at 3,100-19 ft.

ILLINOIS WILDCAT COMPLETIONS

Franklin County: George Allison 1 Shirley, SE NE NE 29-5s-3e, dry at 3,131 ft., Menard 2,048 ft., Cypress 2,574 ft., Paint Creek lime 2,620 ft., Aux Vases 2,785 ft., Ste. Genevieve 2,840 ft., Fredonia 2,931 ft.

Jefferson County: Kewanee 1 E. G. Webb, NE NW SW 4-3s-3e, dry at 2,950 ft., Menard 2,014 ft., Cypress 2,495 ft., Benoist 2,655 ft., Ste. Genevieve 2,783 ft., Fredonia 2,842 ft.

Hancock County: Dale Hopkins 1 E. Aleshire, NW NW NE 18-4n-5w, fourth

principal meridian, dry at 925 ft. No log available.

Saline County: Jarvis Bros. and Marcell 1 Rufus Raley, NW SW SW 10-10s-6e, dry at 2,075 ft., lower Menard 1,503 ft., Waltersburg 1,515 ft., Cypress 1,953 ft., TD 2,075 ft.

Wayne County: Felix Jablonski 1 Yorndorf, C NW NW 3-1n-9e, pumped 49 bbl., Aux Vases sand at 3,100-19 ft., TD 3,226 ft., PB to 3,219 ft.

Stanolind 1 Seifert-Fisher, W½ SW NW 35-2s-9e, dry at 3,409 ft., Menard 2,445 ft., Cypress 2,950 ft., no Benoist reported, Aux Vases 3,226 ft., Ste. Genevieve 3,276 ft., Fredonia 3,309 ft., McClosky 3,332-36 ft.

TEXAS GULF COAST

Two Gas-Condensate Wells Discover New Fields

HOUSTON, Tex.—Two new gas-condensate fields in Colorado County, one in the Cockfield and the other in the Wilcox, featured Texas Upper Gulf Coast development last week.

Cockfield production was opened by Ohio Oil Co. about 5 miles southwest of Garwood, in Section 792, AB&M Survey A-720, at the 1 C. W. McDermott. Drilled to 7,087 ft., 5½-in. set at 6,853 ft., perforations at 6,510-20 ft. the well developed a flow of 6,000,000 cu. ft. of gas with 60 bbl. condensate per day on drill-stem test, using ¼-in. chokes. Tubing has been run and production test is under way.

The Wilcox discovery was at Jack Frazier and Cities Service Oil Co. et al 1 C. K. Gay Unit, 3 miles northwest of Columbus in James Tumlinson League. Drill-stem test through perforations at 7,810-12 ft. showed for 1,552,000 cu. ft of gas on ¼-in. chokes, with 43 bbl. condensate and 2.3 bbl. of water. These perforations were squeezed off and new perforations were made at 7,675-80 ft. for a second test which is now under way.

Two developments of interest were recorded in Chambers County. Salt Dome Oil Co. et al 1 Mrs. Dolce Ogden, Lot 3, Evan Douthit Survey, at South Anahuac was showing 8,280,000 cu. ft. of gas daily with considerable condensate on ⅜-in. choke from perforations at 9,000-40 ft. to again turn attention to possibilities of the deep sand. Sun Oil Co. extended the Fig Ridge field northward at the 1 Federal Land Bank et al, in Section 81, T&NO Survey A-251. The test, on preliminary gage, flowed 170 bbl. of oil in 17 hours on 10/64-in. choke from perforations above 8,633 ft. in the regular pay.

A southwest extension test was completed at Clodine field, Fort Bend County, at Providence 1 Dorrance-Wing, which flowed 102.66 bbl. a day on 7/64-in. choke on tubing set at 7,490 ft.

TEXAS UPPER GULF COAST WILDCAT COMPLETIONS

Fort Bend County: H. M. Naylor Oil Co 2 V. S. Randle, wildcat, Jane H. Long Sur., 1½ mi. E of Richmond, dry at 9,183 ft.

Jefferson County: Glenn H. McCarthy 1 J. T. Shelby et al, wildcat 3 mi. S of Nederland, in T&NO Sur. 11, dry at 10,585 ft.

Wharton County: J. B. Ferguson & Stewart Boyle 1 J. W. Kubela, H&TC Sur. 5, 6 miles W of Pierce, dry at 5,012 ft.

Jackson County: Seaport Oil Co. 1 John M. Bennett, Blk. 30, first regular subd. of J. M. Bennett Ranch, R. Musquez Gr., 1 mi. NW of West Ranch field, 1½ mi. W of Vanderbilt townsite, TD 5,785 ft., top pay sands 5,060 and 5,580 ft., 2-in. set at 5,554 ft., dual completed. Frio sand perf 24/5,580-84 ft., flowed gas-condensate, no gage, Marg. sand perf. 18/5,063-67 ft., flowed 48.27 bbl. daily, 7/64-in. choke. Discovery.

MICHIGAN

Fork-Mecosta Well Best Producer Out of Three

SAGINAW, Mich.—Three oil wells, one small gasser and five failures were registered in Michigan last week. A new producer in the Fork-Mecosta field gaging initial of 238 bbl. daily was the best well of the week. Smaller producers were reported in Cass and Ottawa counties.

Eight more drilling permits, raising the 1944 cumulative to 32, were

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issued by Conservation Commission. Allegan and Van Buren counties received two each, the others going to Antrim, Newaygo, Osceola and Roscommon.

MICHIGAN WILDCAT COMPLETIONS

Allegan County, Watson Township: Southwest Development Co. 1 Hugh MacDougall, NE SE NE 23-2n-12w, dry in Traverse limestone, TD 1,711 ft.

Isabella County, Lincoln Township: C. L. Maguire, Inc., 1 Hoag & Gress, N½ NE SW 11-13n-4w, dry in Dundee, TD 3,699 ft.

LA.-ARK.

Union County Wildcat Opens New Gas Field

SHREVEPORT, La.—Atlantic Refining Co.'s 1 Murphy, NW SW 2-18s-18w, was brought in last week as a dry gas well, estimated at 50,000,000 cu. ft. a day. The well has shown some possibilities of oil production and the company announced that the flow of gas would be killed with mud so that an additional oil test might be made at 7,860 ft.

The Arkansas Oil and Gas Commission, after examining cores, hailed it as a gas discovery and named it the Wilks field. Location is about 2 miles northwest of Schuler.

ARKANSAS WILDCAT COMPLETIONS

Logan County: Ark-La Gas Co. 1 J. W. Roberts, SE NW NW 33-8n-22w, dry, TD 4,747 ft.

Miller County: Garland Anthony 1 Grace, NE NE 9-15s-27w, dry, TD 6,465 ft., Cotton Valley 5,140 ft., Smackover 6,386 ft.

NORTH LOUISIANA WILDCAT COMPLETIONS

Caddo Parish: Delta Drlg. Co. 1 J. W. Dunn, SE NE SE 14-17n-16w, dry, TD 6,431 ft., Austin 2,350 ft., Paluxy 2,505 ft., Pettit 5,597 ft., Travis Peak 5,881 ft.

Morehouse Parish: Texas Co. 1 Louisville Cooperage, NE NW 6-22n-9e, dry, TD 5,450 ft.

Union Parish: Westgate-Greenland 1 Frost Lbr. Co., SE SE 26-22n-1e, dry, TD 5,033 ft., red beds 2,840 ft.

ALABAMA COMPLETION

Washington County, approx. 8 mi. W of Chatom: Humble Oil & Ref. 1 C. D. Scott, NW NE 28-6n-4w, dry, TD 7,860 ft.

PERMIAN BASIN

New Ellenburger Pool in Pecos Due Prompt Drilling

MIDLAND, Tex.—A new pool, producing from Ellenburger dolomite, has been discovered in north Pecos County, 9 miles south of the latest discovery from this pay. The new strike is Standard Oil Co. of Texas 1 Mac-Der Co., NE NW Section 36, Block 144, T&S Ry. Survey, which had 24 ft. of Ellenburger pay from 4,706 ft. to 4,735 ft., total depth. On drill-stem test the discovery showed 200 ft. oil in 8 minutes, and 7-in. casing was cemented above the pay. This well seems to be on the south flank of the Ellenburger ridge that runs across northern Pecos County in a northwesterly-southeasterly trend, since it is about 700 ft. lower than the new strike of Bryce McCandless 1 Atlantic Refining southeast of Owego, on top of Ellenburger, and wells on the same strike between the McCandless-Apco-Warner-Wentz pool trend and this well hit granite at a lesser subsurface depth. Early exploitation of the new area may be expected owing to early expiration of leases in the vicinity. Two locations, one a north offset, and the other ½ mile west, already have been staked, both on leases that expire in 3 months.

Hockley County.—A new pool from the lower Slaughter pay was indicated in northwest Hockley County by Stanolind Oil & Gas Co. 1 Tom Cobb, in the southeast corner of Block 103-E, League 75, Haskell County School Land, which cored oil-stained dolomite from 4,639-54 ft., and recovered a bleeding core from 4,652-69 ft. This test is 4 miles north of Brown & Wheeler 1 French, which had a show of oil in this horizon, but continued to 6,505 ft. without developing production.

Andrews County.—Humble Oil & Refining Co. 1 W. F. Carter, Section 23, Block A-46, PSL, west of the Deep Rock area, attracted attention when it showed oil and gas in mud on drill-stem test from 10,234-60 ft. Second drill-stem test failed, and a third was being attempted. This horizon was first reported to be Mississippian, but definite determination has not been made. It is possible that it may be lower Pennsylvanian, or Bend, Devonian or Silurian. Final completion gage on The Texas Co. 1 J. E. Mabee, discovery in southeast Andrews, which has been standing for some months, showed 312 bbl. per day on pump from total depth 4,704 ft.

Crane County.—Another and shallower pay for the Sand Hills pool has been discovered at Gulf Oil Corp. 45 Waddell, SW SW Section 27, Block B-26, Public School Land, which lost circulation from 3,144-90 ft., and when an attempt was made to mud off the crevice, the well blew out and flowed an estimated 25,000,000 cu. ft. gas and 2,000 bbl. oil. This pay is about 1,000 ft. above the regular Tubb pay of the Clear Fork, and usually shows gas in other wells drilled in the pool. The McKnight pool, 4 miles northwest, produces from this horizon.

(Continued on page 164)

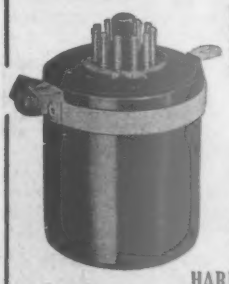
APPALACHIAN FIELDS

Gas Completions Increase In West Virginia

PITTSBURGH, Pa.—United Carbon Co. completed two gas wells last week on Siler Coal Land Co. property in Peytona district, West Virginia, in the Big lime. The 12 Siler gaged 2,439,000 cu. ft. of gas with the Big lime topped at 1,306 ft. and total depth 1,487 ft. and the 15 Siler gaged 4,696,000 cu. ft. of gas from Big lime topped at 1,160 ft. and drilled to 1,346 ft. Another fair gas well was in Upshur County, where Cumberland and Allegheny Gas Co. completed 351 E. L. Neely in the Fifth sand with a gage of 2,155,000 cu. ft. of gas, total depth 2,147 ft.

In Southwest Pennsylvania, Car-

Geophysical Transformers



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negie Natural Gas Co. deepened 2 Clell Gilkerson, in Washington County, with 500,000 cu. ft. of gas showing up in the Gantz sand at 2,279-81 ft.; total depth 2,290 ft.

In Mercer County, United Natural Gas Co. is continuing the deep test on the Maude Davidson farm in Worth Township and drilling at 7,048 ft. The Clinton sand (white Medina) and red Medina (lower Silurian) appear missing with Trenton the next possibility.

OHIO, KENTUCKY

Large Gasser Completed; New Field Discovered

ZANESVILLE, Ohio.—One of the best wells to be completed in the Sandyville field was drilled by C. R. Obermiller on the Van Voorhis tract in Section 1, Bethlehem Township, Stark County. The Clinton pay was found at 4,590-4,618 ft. The well gaged 4,155,000 cu. ft. of gas, after shot, with a rock pressure of 1,345 lb.

Indications of a new gas pool in Lorain County was found by Hanley & Bird. Their discovery, on the Tessie Miller in Lot 84, La Grange Township, apparently found the edge of a sand lens at 2,365-68 ft. and gaged 2,540,000 cu. ft.

OHIO WILDCAT COMPLETIONS

Lorain County, La Grange Township: Hanley & Bird 1 Tessie Miller, Lot 84, Clinton 2,365-68 ft., 2,540,000 cu. ft. gas, T.D. 2,372 ft.

Muskingum County, Hopewell Township: Atha 1 George Edwards, Sec. 23, Clinton 3,385-3,422 ft., dry, T.D. 3,525 ft.

WESTERN KENTUCKY

OWENSBORO, Ky.—Operators in the Utley pool, in Union County, 6 miles east of Uniontown and 4 miles south of the Smith pools, have agreed to limit production of wells to 125 bbl. per day per well. Ashland Refining Co. and Basin Drilling Co. 1 C. E. Moore, the latest completion, pinched down to 125 bbl. daily, is estimated to be good for 1,000 bbl. a day open flow. Eight wells, all oil producers, and all in established pools, were completed in the past week.

EASTERN KENTUCKY

ASHLAND, Ky.—Eastern Kentucky operations this week included the completion of one oil well and a dry hole.

INDIANA

EVANSVILLE, Ind. — Three oil wells and 10 dry holes comprised the completed work in the field in Indiana last week.

INDIANA WILDCAT COMPLETIONS

Sullivan County: J. W. Rudy 1 Wabash Valley Land Co., SE NW NW 10-6n-10w, dry at 2,968 ft., base of Mississippi lime 2,412 ft., Devonian lime 2,690 ft.

Vanderburgh County: Ryan Oil 1 Barrett & Wathem, C SE NE 1-7s-10w, dry at 2,357 ft., Glen Dean 1,552 ft., Ste. Genevieve 2,189 ft.

CANADIAN FIELDS

Deep Saskatchewan Tests Near Final Determination

CHATHAM, Ont.—Definite results are likely from the deep tests in southern Saskatchewan within the next few weeks. Norcanols-Parry 1, LSD 16, 8-9-21w2, has set packer for test at 9,042 ft. This test has drilled through the Jurassic, Madison, Devonian, Silurian and Ordovician limestones, with numerous shows, the best being in the Ordovician and in the Devonian lime around 7,600 ft. Norcanols-Ogemaw 1, LSD 4, 24-7-23w2, bottomed below 9,400 ft., has set plug from 9,000 ft. preparatory to testing. Norcanols-Corinne 1 has been spotted in LSD 15-16, 32-13-20w2. Oil Ventures 1 is a location about midway between the Parry and Corinne tests.

Imperial Oil, Ltd., is extending its operations to the east in Turner Valley. Imperial 1, LSD 5, 9-18-2w5, is rigging, immediately east of one of the Northwest-Hudson's Bay producers, and offsetting Major-National 16 drilling test to the north. Recent completions in this area have indicated the possibility of important production south and east of the proven field.

Northern prospects. — A summary of the results of geological work carried on in various areas last year by the Geological Survey of Canada indicates good prospects in northern areas served by the Alaska Highway. Investigations from Pouce Coupe to Fort Nelson disclosed the presence of several anticlinal folds with closure.

OKLAHOMA

Canadian County Gets First Commercial Production

EXTENSION of the West Edmond field 1½ miles northwest, across the border, gave Canadian County its first oil well. Dickey Oil Co. 1 K. Young, SE NW 25-14n-5w, flowed 113 bbl. of oil an hour through ⅝-in. tubing choke before being shut in for storage. Hunton lime, topped at 6,970 ft., was perforated at 7,000-20 ft. Total depth was 7,111 ft. The 1 Young is reported to be one of the largest wells yet completed in the area. Tubing and casing pressures were 1,200 lb. and 600 lb.

Other outpost wells are nearing the Hunton zone and will indicate the trend of the field. Fox & Fox 1 Peterson, NE SW 19-14n-4w, 1½ miles north of production, was drilling at 6,820 ft. at the end of the week and looking for the lime. West of the field, Herbert J. Schmitz 1 Specht, SE NE 36-14p-5w, was bottomed at 7,100 ft. and set pipe at 7,070 ft. This well was drilled by Sohio Petroleum Co.

OKLAHOMA WILDCAT COMPLETIONS

Cleveland County: Mid-Continent 1 Harris, NE SE SW 29-10n-3w, flowed 223 bbl. in 23 hr., 10/64-in. choke, 38.7 gravity, second Wilcox 8,784-92 ft., discovery of W. Moore.

Garvin County: Ohio Oil Co. 1-A Hutchins, SE NE NE 26-4n-1w, dry, TD 4,147 ft., sand 4,078 ft.

Hughes County: Sonac Oklahoma Oil & Gas 1 Rose, NE SW SE 17-7n-10e, dry, TD 3,984 ft., Cromwell 3,867 ft.

Muskogee County: Claude Garrett 1 Rafter, SW NW SW 31-14n-18e, dry, TD 998 ft.

Okmulgee County: Dunn-Miller 1 Kennedy, SW SW NE 31-14n-11e, dry, TD 3,251 ft., Bartlesville 1,950 ft., Wilcox 3,240 ft.

Seminole County: Gulf 1 Duley, SE SE SE 28-10n-7e, flowed 183 bbl. in 24 hr., Booch 3,415-43 ft., TD 3,563 ft.

Gulf, Magnolia & Buttram 1 Springs, NW NW SW 16-2n-7w, dry, TD 10,006 ft., PB 9,340 ft. to test sand at 9,292-9,314 ft., packer failed.

ROCKY MOUNTAIN

Deepest Rocky Mountain Test Fails at Lance Creek

DENVER, Colo. — The deepest well drilled in the Rocky Mountain area and also an important wildcat, Superior Oil Co. 1-A Ong, C SE SW 31-36n-65w, on the northwest flank of Lance Creek, was abandoned at 10,910 ft. It had water in the Dakota, basal Sundance and Leo sands. It was a northwest offset to Continental Oil Co. 10 Otto Rohlff, which was completed in 1939 for 1,898 bbl. daily in the Leo sand. Between the two locations is a fault which revealed a downthrow of more than 5,000 ft. The Superior well had the top of the basal Sundance at 9,280 ft. and the Continental well reached that horizon at 4,175 ft.

COLORADO WILDCAT COMPLETIONS

Kit Carson, Cheyenne County: O. E. Terry 1 Ruff, C SW NE 24-13s-49w, dry at TD 4,861 ft., slight odor of oil in Marmaton lime at 4,774-76 ft.

WYOMING WILDCAT COMPLETIONS

Lance Creek, Niobrara County: Superior Oil Co., 1 Ong, C SE SW 31-36n-65w, TD 10,910 ft., water in Leo sand, also in basal Sundance at 9,280-9,300 ft., and Dakota at 8,723-56 ft., dry.

Kit Carson wildcat abandoned.— O. E. Terry 1 Ruff, C SW NE 24-13s-49w, Cheyenne County, eastern Colorado, the third wildcat drilled in that immediate area, was dry in the Marmaton sand, in which it had only a faint odor of oil, at 4,861 ft. It was a

(Continued on page 161)

Wildcat Completions and Discoveries

	Week ended January 29, 1944					Cumulative total for 1944				
	Oil	Distillate	Gas	Dry	Total	Oil	Distillate	Gas	Dry	Total
Ohio	0	0	1	1	2	0	0	2	4	6
Indiana	0	0	0	2	2	0	0	0	2	2
Kentucky	0	0	0	1	1	0	0	0	7	7
Illinois	1	0	0	5	6	2	0	0	24	26
Michigan	0	0	0	2	2	1	0	0	16	17
Kansas	0	0	0	6	6	2	0	0	24	26
Nebraska-Missouri-Iowa	0	0	0	1	1	0	0	0	5	5
Oklahoma	2	0	0	5	7	3	0	1	14	18
Texas:										
North Central	1	0	0	9	10	3	0	0	23	26
West	1	0	0	1	2	2	0	0	11	13
Panhandle	0	0	0	1	1	0	0	0	1	1
East	0	0	0	0	0	0	0	0	14	14
Gulf Coast	1	1	0	4	6	5	2	1	13	21
Southwest	0	0	2	4	6	5	0	2	21	28
Total	3	1	2	19	25	15	2	3	83	103
Louisiana:										
North	0	0	0	3	3	0	0	0	4	4
Gulf Coast	0	0	0	1	1	0	2	0	6	8
Total	0	0	0	4	4	0	2	0	10	12
Arkansas	0	0	0	2	2	0	0	0	3	3
Mississippi and Southeast	0	0	0	3	3	0	0	0	11	11
Montana	0	0	0	0	0	0	0	0	1	1
Wyoming	0	0	0	1	1	0	0	0	2	2
Colorado, Utah	0	0	0	1	1	0	0	0	1	1
New Mexico	5	0	0	0	0	0	0	0	5	5
California	0	0	1	5	6	0	0	2	13	15
Total United States	6	1	4	58	69	23	4	8	225	260
Total previous week	8	2	0	41	51					

NEW discoveries completed last week included a promising new field in Oklahoma, a large well in West Texas and six other oil wells of less importance.

Mid-Continent Petroleum Corp.'s West Moore discovery in Cleveland County, Oklahoma, was completed at a conservative 223 bbl. of oil a day. Flow is through tubing choke from the second Wilcox sand. This well is thought to be on a second trend parallel to the Nemaha Ridge and if so will be the forerunner of new pools to the north of it. Offsets are near the pay zone and within the next two weeks should indicate the trend.

In Andrews County, West Texas, Bay Petroleum Co. 1 Bitler & Lowe, opened the East Fullerton pool with a flow of 850 bbl. of 42-gravity oil in the Clear Fork lime at 6,900 ft. Location is 1½ miles northeast of production at Fullerton.

KANSAS

Field and Exploration Programs Show Increase

KANSAS operations were up again last week when a total of 45 wells were completed, including 22 oil wells and 2 gas wells. Field and exploration activity is showing an increase, part of which is seasonal.

Skelly Oil Co.'s 1 Dowell, NE SE NE 22-28-12w, a northwest extension to the Chitwood pool, was reported flowing 45 bbl. an hour through tubing. Top of the Simpson was 4,380 ft. and pipe set at 4,408 ft.

A number of Kansas operations that have opened new pools are now waiting on pumping equipment and final tests before completion. These include Continental Oil Co. 1 Bruggeman and Champlin Refining Co. 1 Marcotte, both in Rooks County; Huber & Barnett 1 Cotton in Trego County, and Sohio Petroleum Co. 1 Frevile in Ness County.

KANSAS WILDCAT COMPLETIONS

Butler County: Wakefield & Sunray 1 Lamumyon, NE NE SW 1-29-6e, dry, TD 3,265 ft., Kansas City 2,122 ft., Mississippi lime 2,800 ft.

Ellsworth County: Falcon-Seaboard et al 1 Janzen, NW NW SE 23-17-8w, dry, TD 3,540 ft., Viola 3,405 ft., Arbuckle 3,507 ft.

Bridgeport Oil Co. 1-A Larson, SW NW NE 1-17-6w, dry, TD 3,473 ft., Mississippi lime 3,083 ft.

Kiowa County: Sinclair Prairie 1 Morford, NW NW NW 2-29-20w, dry, TD 5,779 ft., Mississippi lime 4,985 ft., Arbuckle 5,608 ft.

Marion County: Falcon-Seaboard 1 Platt, NE NW NW 29-19-1e, dry, TD 2,880 ft., Mississippi lime 2,870 ft.

Russell County: Nadel & Gussman 1 Luermann, SE SE NE 24-15-13w, dry, TD 3,344 ft., Kansas City 3,032 ft., Arbuckle 3,323 ft.

FOREST CITY BASIN

ST. JOSEPH, Mo.—Ohio Oil Co. has been working on a Nemaha County, Kansas, wildcat in an effort to develop production from Hunton lime. After plugging back from 3,000 ft., 7-in. casing, which had been set at 2,878 ft., was perforated at 2,827-30 ft. and at 2,863-65 ft. More perforations were made at 2,840-50 ft. and a showing of oil there was acidized with 200 gal. The test swabbed 60 bbl. of water an hour with a slight showing of oil.

B. B. Blair of Tulsa had a dry hole at 1 Cox, C SW SW 10-4s-7e, Marshall County, Kansas.

NEBRASKA WILDCAT COMPLETION

Nemaha County: Short 1 Gauchat, NW NW 23-6n-13e, dry, TD 1,970 ft., Hunton 1,921 ft., show dead oil 1,947 ft.

CRUDE-OIL PRICES

Representative selected crude prices from all sections of the country appear below:

East Texas	$1.25
Conroe	1.49
Tepetate, Louisiana	1.19
Illinois basin	1.27
Pecos County, Texas	.99
Bradford, Pennsylvania	3.00
Van, Van Zandt County, Texas*	1.00

*No change since 5-21-41.

Gravity Schedules

Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

Gravity—	Signal Hill, Calif.	Oklahoma, Kansas	Gulf Coast Texas	West Texas*
18-18.9	$0.80	....	....	....
19-19.9	.84	....	$1.06	$0.70
20-20.9	.88	$0.85	1.08	.72
21-21.9	.92	.87	1.10	.74
22-22.9	.96	.89	1.12	.76
23-23.9	1.00	.91	1.14	.78
24-24.9	1.03	.93	1.16	.80
25-25.9	1.07	.95	1.18	.82
26-26.9	1.11	.97	1.20	.84
27-27.9	1.15	.99	1.22	.86
28-28.9	1.18	1.01	1.24	.88
29-29.9	1.20	1.03	1.26	.90
30-30.9	1.23	1.05	1.28	.92
31-31.9	....	1.07	1.30	.94
32-32.9	....	1.09	1.32	.96
33-33.9	....	1.11	1.34	.98
34-34.9	....	1.13	1.36	1.00
35-35.9	....	1.15	1.38	1.03
36-36.9	....	1.17	1.40	1.04
37-37.9	....	1.19	1.42	1.06
38-38.9	....	1.21	1.44	1.08
39-39.9	....	1.23	1.46	1.10
40 and above		1.25	1.48	1.12

*Includes Lea County, New Mexico

Market Developments

THE unbalance of supplies and transportation facilities continued this week to plague refiners in their concerted efforts to meet wartime demands for products. Inflated requirements for products without commensurate increases in regional transportation facilities joined with general shortages to hold manufacturers under extreme pressure in order to prevent a complete breakdown in supply and distribution.

Additional tank cars have been returned to service between District 2 and 3 supply centers and the East Coast, particularly in delivery of larger quantities of kerosene. District 2 refiners reported that PAW's supply program over the next few weeks called for reductions in eastern shipments of gasoline in order to make the tank cars available for movement of kerosene.

Current demand for kerosene is almost exclusively related to domestic heating, defense-housing projects, military camps and export movement. Still, it is an interesting sidelight that the new jet-propulsion planes now undergoing extensive experimental tests are operated on fuels essentially having the specifications of a good quality kerosene.

Liquidation of gasoline supplies on the Pacific Coast which proceeded at an alarming rate during the last 6 weeks of 1943 appears to have been temporarily arrested. The interruption in heavy drafts on stocks is believed to be a result of seasonal lulls in automobile operation. Rationing boards on the Pacific Coast have tightened regulations on the issuance of supplementary coupons and investigators are working extensively to stamp out misapplication of supplies allocated to agricultural consumers. Reports from California indicate that lax enforcement of rationing regulations among agricultural consumers was the source of much black-market trading.

Scattered and inconclusive reports from Gulf Coast operations indicate that approximately half of the current tanker loadings are earmarked for "unknown destinations." Evidence that approximately 50 per cent of the products delivered by water from Gulf Coast refineries are discharged at domestic ports, however, is substantially higher than prevailed during earlier phases of the war. This trend indicates, of course, that many of the fuel dumps in the European theater are abundantly stocked and that much of the future requirements will be largely for replacement of current consumption. Refiners generally feel that the industry and public will be amazed at the enormity of petroleum required for establishment of adequate military-fuel dumps when the data can be released.

The statistical position of kerosene, weakest of the major petroleum products on the East Coast, continues to deteriorate. During the past 4 weeks, stocks in District 1 have declined approximately 15 per cent.

While stocks generally are better than they were a year ago, they are still uncomfortably low despite the fact that shipments are now averaging about 35 per cent greater.

The improvement which has been apparent in distillate heating oil has been reflected in a recent action affecting the lowest consuming area in District 1. The four south Atlantic states in the district had the value of coupons established at 10 gal. for Period 4 and 5 rations.

A.P.I. Refinery Report

Week Ended January 22, 1944

(Figures in thousands of barrels)

	Dly. crude runs to stills	Stocks: Gasoline	Stocks: Residual	Stocks: Gas oil
Appalachian	149	2,973	333	918
Ind., Ill., Ky.	789	18,456	3,141	5,531
Okla., Kan., Mo.	377	7,494	1,086	1,753
Censored area*	2,120	36,039	15,535	19,373
Rockies	114	1,585	612	386
California	819	15,216	32,724	10,335
Total 1-22-44	4,368	79,763	53,431	38,269
Total 1-15-44	4,203	†78,557	†54,327	†39,925
Total 1-23-43	3,555	86,086	71,689	40,303

*Reports combined on East Coast, Texas Gulf Coast, Louisiana-Arkansas and Inland Texas at request of PAW. †Revised.

CRUDE-OIL STOCKS

Week ended:	Bbl. of crude*
January 21, 1944	238,814,000
January 14, 1944	238,148,000
January 23, 1943	233,733,000

*Excludes unrefinable stocks in California.

REFINERY PRICE SUMMARY

(Prices as of February 1, 1944)

Quotations are f.o.b. plant in cars and in cents per gallon except where otherwise noted. They are exclusive of the federal excise taxes of 1.5 cents a gallon on gasoline and 4.5 cents a gallon on lubricating oils, and do not include marine lighterage charges.

REFINERY GASOLINE

Octane (A.S.T.M.):	80†	72-74	68-70	63-66
Mid-Continent*	‡6.00-6.25	5.750-6.000		5.520
Gulf Coast	6.06-6.50	§5.750-6.250	§5.750-6.250	§5.250-5.750
Northeast Coast	9.80	9.2	9.2	.....
California	.....	6.255-6.500	5.750-6.125	5.125-5.500

*Basis Group 3. †1939 C.F.R. (research method). ‡Inland Texas and adjoining counties in Arkansas and North Louisiana. §Unleaded.

KEROSENE AND DISTILLATE FUEL OIL

Product—	Kerosene†	No. 2	No. 3	No. 5	No. 6‡
Mid-Continent*	4.125-4.375	3.500-3.625	3.375-3.500	$0.85	$0.80-1.27
North Louisiana*	4.125-4.375	3.500-3.625	.....	.....	0.80-1.27
Pennsylvania	6.000-6.125	5.875-6.125	5.875-6.000	.....	.....
California	4.500-5.500	5.500	5.500	§1.10-1.26	§1.10-1.15
Northeast Coast	6.800	6.700	6.700	1.95	1.95
Gulf Coast	4.125	3.750-3.875	.....	1.26	0.95

*Reflecting OPA ceilings, depending on destination of shipments. †Quotations for 41-43 gravity. ‡Range depends on gravity. §Pacific Specification 300. ¶Pacific Specification 400.

NATURAL GASOLINE

Grades:	26-70	18-55
Oklahoma (Group 3)	4.750	5.700
North Texas	4.375	5.250
North Louisiana	4.375	5.250
California	4.875	5.500

LUBRICANTS

PENNSYLVANIA GRADE—	
Bright stock*, 10 pour point	30.5
Bright stock*, 25 pour point	25.0
Steam refined, 600	15.0
Neutral oil†, 10 pour point	34.0
Neutral oil†, 25 pour point	28-32.5

*No. 8 color, 145-155 at 210, 540-550 flash. †150 vis. at 70 F., 3 color, 400-405 flash.

MID-CONTINENT—	
Bright stock, 150-160 D, 0-10	23.00
Neutral oil†, 200-3	15.00

†0 to 10 pour point.

GULF COAST—	
Pale oil, 200-3	8.75
Pale oil, 500-3½	10.00

WAX

Oklahoma, 124-126, w.c.s.	4.200
Pennsylvania, 122-124, w.c.s.	4.200
NEW YORK (in bags)—	
Refined, 130-132 (A.m.p.)	7.00
Crude, 124-126 (W.s.)	6.00

TANK-WAGON PRICES

(Gasoline prices based on regular grades in cents per gallon).

	Dealer tank wag.	Com- bined tax	Kero. tank wag.
Baltimore, Md.	15.95	5.5	10.5
New York	16.10	5.5	10.1
Philadelphia	16.20	5.5	11.9
Washington, D. C.	15.20	4.5	11.3
Chicago	14.10	4.5	10.6
Cleveland, Ohio	14.50	5.5	*9.0
Atlanta, Ga.	16.90	7.5	*11.5
Denver, Colo.	14.50	5.5	11.9
San Francisco	14.50	4.5	11.5
Tulsa	16.50	7.0	8.5

*Includes 1 cent state tax.

Among the

Drilling Contractors

Bell & Loffland, Los Angeles, Calif., has been awarded a contract to drill a wildcat near Marshfield, Ore., to 6,000 ft. unless production is developed sooner.

Big Chief Drilling Co., Oklahoma City, Okla., is the contractor on Mid-Continent Petroleum Corp. 1 Westermier, NE SW SW 20-10n-3w, west of Moore, Okla., and east of the new West Moore field in northern Cleveland County.

Morris-Hamilton Drilling Co., Houston, Tex., has contracted to drill Union Oil Co. of California 3-W Gray et al, 34-10s-12w, in the Vinton field, Calcasieu Parish, Louisiana.

C. A. Tucker, Houston, Tex., has been awarded contract by E. H. Robertson of Louisiana to drill his 1 Vincent heirs, SW 34-10s-12w, in the Vinton field of Calcasieu Parish, Louisiana. This is a 6,000-ft. test in search of the regular flank pay sands.

Cron & Gracey, Houston, Tex., have the contract to drill Shell Oil Co., Inc. 14 Pelican in the Gibson field of Terrebonne Parish, Louisiana, in 35-17s-15e, projected to 9,500 ft.

Al Buchanan, San Antonio, Tex., is rigging up The Texas Co. 1 Jose Maria Valadez, outpost test in the Magnolia City area, Jim Wells County, Tex., SA&MG Survey 101, A-487, and is scheduled to 7,500 ft.

Texas Petroleum Co., San Antonio, Tex., has contract to drill Highland Oil Co. 7 Halff & Oppenheimer in the Pearsall field of Frio County, Texas. This 3,900-ft. test is in John H. Gibson Survey 16. Rig is on the location for immediate spudding.

Eastland Oil Co., Fort Worth, Tex., headed by George Donnelly, will drill a 6,000-ft. Ellenburger test in Crane County for James Fitz-Gerald, Jr., and I. T. Dennis. The test, 1 O. B. McPherson, N¼ N¼ Section 16, Block 35, H&TC Survey, is in an area regarded favorably for production from Simpson and Ellenburger formations by virtue of shows encountered in nearby tests.

J. W. Lang Co. is the drilling contractor on Michigan Devonian Petroleum Co. and J. W. Lang Co. 2 Dozemen-Vanden Beldt, in NE SE NE 11-4n-15w, Allegan County, Michigan.

Fisher-McCall Oil & Gas Co. has been awarded contract to drill the James T. McGerry, Tr., 1 Conrad Havemen, in SE NW NE 30-2n-11w, Allegan County, Michigan.

Gordon Oil Co. is the drilling contractor on Sohio Petroleum Co. 1 East Jordon Lumber Co., in S½ NE NW 9-31n-7w, Antrim County, Michigan. Same contractor will drill the Smith Petroleum Co. and Rowmor Corp. and C. W. Teater 2 Franz-Ruhl, in S½ SE NW 6-18n-9w, Osceola County, Michigan.

J. C. Arthurs, Inc., a veteran drilling-contracting firm in Michigan, is now in process of effecting a liquidation and dissolution of the company, according to Emil Fielder, secretary-treasurer. The company has not accepted any new contracts since January 1. The company will dispose of its equipment, which includes seven strings of tools and one drilling machine.

George Echols has the drilling contract on Chicago Mill & Lumber Co. 2 Mutual, a Wilcox test in SE SE 12-11n-9e, at Holly Ridge, Tensas Parish, Louisiana.

E. F. Moran has the drilling contract on Sun Oil Co. 1 Burgener, a wildcat in SE SE SE 28-4n-14w, Richland County, Illinois, a mile north of Claremont. Contract is for the McClosky on a 1,000-acre block.

Harper-Knappenburger has the drilling contract on Champlin Refining Co. 3 Nettie Tibbs, in Block 6 of the William McDonald Survey, Jack County, Texas, and was moving in for a 3,500-ft. test in the McDonald field.

Kerlyn Oil Co. has the contract to drill Herbert S. Schmitz 1 Arnold, in C NE SW 29-14n-4w, a north offset to the Peppers 2 Arnold producer, in the West Edmond field, Oklahoma County, Oklahoma. Kerlyn will also drill the Sohio 2 Beam, in C SW NW

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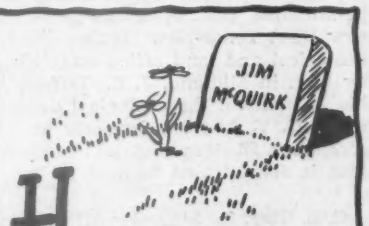
TULSA, OKLAHOMA

29-14n-4w, halfway between the operator's 1 Beam and 1 Briscoe on the north line of the West Edmond field.

J. I. Roberts has been awarded drilling contract on Arkansas Fuel Oil Co. 1 Nettie Gibson, in NW SW 7-11n-10e, the Holly Ridge area, Tensas Parish, Louisiana.

Taber & Coleman has been awarded contract to drill Sohio Petroleum Co. 1 Leonard, in C SW NW 30-14n-4w, on the Oklahoma County, Oklahoma, side of the West Edmond field. This is an east offset to the Dickey Oil Co. 1 Kate Young, which extended production into Canadian County last week.



Here lies the body
Of Jim McQuirk
He hung up his line
And lost his shirt

Brodie would never have used a Baker Rotary CASING Scraper—he would have taken a chance like our friend Jim, bless his soul. Jim figured the inside of the casing was clean—no scale, no burrs from gun-shot holes, no hardened cement. There's a new driller on the rig now and also a Baker Rotary CASING Scraper. This is one of the sweetest, simplest, most business-like tools you ever saw . . . turn to Page 275 of the 1942 Composite (or Baker) Catalog and look it over—or write us for a swell portrait of it.

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BAKER OIL TOOLS, INC.

(Just in case you might want to use one of 'em look on Page 226.)

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Truck Shortage Handicaps Drilling Program

Drilling contractors may be unable to drill the necessary number of wells expected of them, owing to lack of trucking facilities, it was disclosed at a recent district meeting in Houston, Tex., of the American Association of Oilwell Drilling Contractors. Inability to obtain the necessary trucks to move drilling rigs has resulted in serious delays in the drilling program, and increased drilling costs. Because of this condition it is estimated that the loss in drilling time ranges from 15 to 35 per cent of the total time. Trucking contractors in attendance at the meeting expressed a willingness to cooperate, but stated that they were unable to buy new equipment or repair parts, that they were short on manpower, and that they had encountered political resistance. They indicated that they were able to get certificates for new trucks, but that the trucks were not to be found. The trucking contractors recommended that the various state regulatory commissions relax certain operating rights to enable the oilfield haulers to render a better service.

Rocky Mountain Area

(Continued from page 157)

mile south of a well drilled in 1938 by Gulf Oil Corp., which created intense excitement when it gave evidence of production.

General Petroleum at Garland.—The hot spot in the area is still General Petroleum Corp. 1 Howell, on the south flank of the Garland dome, which cemented the 7-in. on top of the Tensleep at 4,302 ft., and is ready to test that horizon. Following a rumor that a 1-ft. core recovered came out bleeding with oil, all avenues of information were closed and land men for the major companies made a rush play for leases.

Little Buffalo Basin still in doubt. Stanolind Oil & Gas Co. 1 Unit, SW NE 34-48n-100w, Little Buffalo Basin, a test on the north dome, is bottomed at 5,326 ft., and cemented the 6⅝-in. in the top of the Tensleep at 4,805 ft. On a swabbing test after acidizing it made 21½ bbl. of water per hour. The water may be coming from the Embar above, and pipe will be recemented. Later the Tensleep will be shot.

Embar at Steamboat Butte.—British-American Oil Producing Co. 2-C Tribal, Steamboat Butte field, a discovery last year in the Sundance sand, had the top of the Embar at 6,443 ft., and on a drill-stem test showed 165 ft. of oil and cut mud, no water nor gas, and is coring at 6,661 ft., for the Tensleep. This is the first well to go below the Sundance.

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Since the start of the war, many users have switched away from old fashioned "thread dopes" and tried RECTORSEAL for the first time. They have found that this modern compound is so far superior to what they had been using that they swear they'll never use anything else.

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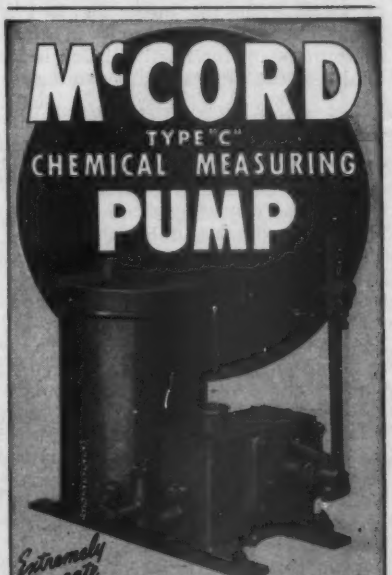

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Standard of the Oil Fields
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RADIATOR & MFG. CO., DETROIT, MICH.

PERSONALS

Myers Began His Oil Career at Famed Spindletop

THE salt-dome theory of petroleum deposits wasn't the only thing that started at the famed Spindletop field in Texas. The oil career of R. N. Myers, recently appointed drilling superintendent for Shell Oil Co., Inc., in the Texas Gulf area, began there too.

Dick, as his intimates call him, went to work as a roughneck in 1917. Nine years' experience as roughneck and driller in Louisiana, California, and Mexico oil fields followed. In 1926 Myers joined the old Roxana Petroleum Corp. as a driller at Smackover, Ark. Roxana merged with Shell shortly afterward, and Myers has remained with the latter organization since. In 1927 he was transferred to Wink, Tex., as a tool pusher, and 2 years later he was advanced to production foreman at Luling, Tex.

In 1934 Myers became drilling foreman at Iowa, La., and 4 years later he was promoted to drilling superintendent of Shell's Louisiana division. He was assigned to the company's Houston, Tex., office as assistant drilling superintendent for the Texas Gulf area in 1940 and last fall was advanced to his present post.

Karl E. Pederson has been promoted from drilling foreman for Shell Oil Co., Inc., at Bakersfield, in the San Joaquin division, California, to division drilling foreman. **Charles W. Prewett,** who was assistant geologist at Ventura, in the Coastal division, has been transferred to a similar position at Long Beach, in the Los Angeles Basin division. **Urban M. Warren,** who was drilling foreman at Sacramento, in the San Joaquin division, has been transferred to a similar post at Oilfields.

Holgar Johnson, formerly scout for Phillips Petroleum Co. at Lafayette, La., has been placed in charge of the company's scouting activities, succeeding **Fred O. Jackson,** who is now district scout at Shawnee, Okla. **Frank King,** formerly scout at Shawnee, has been transferred to Wichita Falls, Tex., taking the place of **Glenn L. Gibson,** who was assigned to the land department.

Joe A. Hale, formerly secretary to **H. N. Pardee,** manager of The Texas Co.'s Oklahoma-Kansas-Illinois producing division, has been advanced to assistant to the division manager. He will handle the company's industrial relations in the division from headquarters in Tulsa. **J. Howard Johnson,** formerly chief scout, succeeds Hale as secretary to the division manager. **Wilson Metcalf,** former scout at Ardmore, Okla., becomes chief scout at the Tulsa office, and **Kenneth M. Heckman,** from the Tulsa scouting department, goes to Ardmore as scout for southern Oklahoma. **Jarrold Green** of Ardmore replaces Heckman.

Maj. Francis R. Blankenship, formerly engineer in Oklahoma City, Okla., for Westgate Natural Gas Co., is now director of the engineering division of Army Service Forces Technical Training Command at Camp Gordon Johnston, Florida.

J. R. Lawrence, formerly of Big Spring, Tex., has been made superintendent of Midwest Refining Co.'s plant at Grandville, Mich., and he is now making his home in that city. **Joe Ernest,** former Oklahoman, is the new superintendent of Midwest's refinery at Alma, Mich.

Alton P. Smith is the new superintendent of Fort-Dale Refining Co.'s refinery at Bloomingdale, Mich. Currently, he is supervising an improvement and expansion program.

Robert G. Dunlop has been appointed controller of Sun Oil Co. and its subsidiaries and affiliates, to succeed F. S. Reitzel, who died recently. He was named a director also to replace Reitzel. Dunlop, who was formerly assistant controller, graduated from University of Pennsylvania in 1931 and joined Sun 2 years later. He was named assistant controller for Sun in 1941.

F. H. McGuigan, for several years geologist for Lion Oil Refining Co. in Midland, Tex., is in charge of the new West Texas-New Mexico district geological and land office established by Lion in Midland. **J. E. Gaffney** is his assistant in the geological department. **C. V. Lisman,** formerly at the company's El Dorado, Ark., headquarters, is district land man.

C. E. Ulry, for 2½ years office manager for Sun Oil Co. in Huntington, W. Va., has been transferred to a similar post in Lansing, Mich. **E. E. Simpson,** formerly in Sun's Philadelphia, Pa., office, succeeds Ulry in Huntington.

Frank Phillips, chairman of Phillips Petroleum Co., was elected a director of Missouri-Kansas-Texas Railroad Co. last week.

Staff Sgt. R. D. Daniels, formerly in the mechanical department of Pan American Refining Corp., Texas City, Tex., is now somewhere in Italy with a tank company. Sergeant Daniels left Pan American in July 1941 and has been in foreign service a year.

J. B. Thompson, purchasing agent for Shell Pipe Line Corp., Houston, Tex., has been appointed assistant director of the materials division, District 3, Petroleum Administration for War. **E. H. Lindsmith,** assistant purchasing agent, will fill Thompson's place during the latter's leave of absence.

R. A. Nelson, formerly district clerk in the oil pipe-line and storage division of Cities Service Oil Co. in East Texas, has been transferred to Lake Charles, La., as delivery superintendent. He is succeeded in East Texas by **Paul Connor,** formerly job order clerk in the Bartlesville, Okla., office. **Frank Fray,** budget clerk, has taken over Connor's former job.

E. W. Masters, formerly manager of the San Joaquin division of Shell Oil Co., Inc., has been promoted to production manager for California. **S. F. Bowlby** has succeeded him. **A. S.**

Baptie has replaced Bowlby as superintendent of the Los Angeles Basin district and will maintain offices in Long Beach.

Frank M. Racher has left Petrolia, Ont., after several months' sick leave for Florida to take a plane for Brazil, where he has a drilling contract with a large operating concern. Racher previously spent about 3 years in Brazil.

Robert S. Sutton, formerly district land man in Tulsa for British American Oil Producing Co., is now superintendent of the company's land department. Sutton was superintendent of the old Indian Territory Illuminating Oil Co.'s land department until its consolidation with Cities Service Oil Co., after which he was district land man for the latter company in West Texas and New Mexico, leaving that post to join British American last year.

R. M. Hess, formerly division production engineer for Shell Oil Co., Inc., at Kilgore, Tex., has been appointed superintendent of a new district in the East Texas area, designated as the Quitman division. The district includes Northeast Texas, North Louisiana, and South Arkansas, with the exception of the East Texas and Chapel Hill fields. It will have two offices, one at Quitman, to handle East Texas, and one at Magnolia, Ark., to handle South Arkansas and North Louisiana.

Ralph E. Knipe, geologist of Owensboro, Ky., who joined Ohio Oil Co.'s Mount Pleasant, Mich., office last October, has taken over the duties of **W. A. Thomas,** geologist there, who has entered U. S. Army service.

J. Paul Jones, of Bradford, Pa., has been named director of production for Pennsylvania Grade Crude Oil Association, a new post. Jones will be responsible for dissemination of facts concerning production among operators in the region covered by the organization.

C. J. Bitzer, formerly technical assistant in the Bayway refinery of Standard Oil Co. of New Jersey at Elizabeth, N. J., in charge of the fluid catalytic-cracking plant, has been transferred to the chemical products department of Stanco Distributors, in New York. **F. S. Sherwood,** of the Bayway refinery, replaces Bitzer there.

Louis Finch, Jr., Stanolind Oil & Gas Co., Midland, Tex., has been elected president of the Permian Basin Engineering Association. **E. H. Griswold,** Goldsmith Engineering Committee, was elected vice president; **H. E. Berg,** Tide Water Associated Oil Co., was reelected secretary-treasurer, and **S. J. Leach,** Humble Oil & Refining Co., was elected program chairman.

M. H. North, formerly supervisor of advertising and sales promotion for Blackstone Valley Gas & Electric Co., of Pawtucket, R. I., has taken a similar post with Oklahoma Natural Gas Co., Tulsa.

Robert S. Ellison has recently been elected president of the Bank of Manitou, Manitou, Colo., succeeding **J. F. Campbell,** who continues as chairman of the board. On retirement from the presidency of both Stanolind Oil Purchasing Co. and Stanolind Pipe Line Co. in November 1940, Ellison purchased Briarcliff, the residence of the late William Bell, founder of Manitou.

Merle Thorpe was elected last week to the board of Cities Service Oil Co. and appointed director of business development. Thorpe is retiring as editor and publisher of Nation's Business.

Leonard R. Seaman, who joined British-American Oil Producing Co. in August 1943, has been appointed general manager of California operations and will maintain headquarters at Los Angeles.

Joseph Jensen, chief petroleum engineer of the Associated division, Tide Water Associated Oil Co., has been appointed a member of the Los Angeles, Calif., Board of Water and Power Commissioners.

R. L. Kidd, chief geologist for Cities Service Oil Co., of Bartlesville, Okla., passed through Denver, Colo., last week on his way to Casper, Wyo., where he will open an office for the company.

Henry Shaw has joined British-American Oil Producing Co. as scout at Midland, Tex. Recently Shaw has been with the Midland Army Air Field as a civilian employe.

J. H. Van Zandt has recently opened offices in the Fort Worth National Bank Building, Fort Worth, Tex., for Eason Oil Co., of Enid, Okla., and Grisso Oil & Royalty Co., Oklahoma City. The companies have joint holdings in the West Central Texas district.

Logan W. Marshall, tax attorney and manager of the general tax department of the Pure Oil Co., Chicago, is retiring from active service February 1. The department will hereafter be directed by **W. V. Keeley,** assistant secretary and assistant treasurer, and by **Guy W. Chase,** assistant manager.

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(Screwed End)

ORBIT FLOW LINE VALVE

A full round opening valve that operates easily under high pressures. No grease required to effect a seal. Compact in design, yet built to "take it."

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will last for the duration. Meanwhile, if you have any questions regarding their care or maintenance, write us.

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Since 1912

TULSA, OKLAHOMA

NEW OFFICERS FOR HOUSTON NOMADS

At a meeting of the Houston, Tex., Chapter of Nomads on January 20 new officers were elected for 1944. They are: Harry Estes, Reed Roller Bit Co., assistant secretary and treasurer; Madden Works, Cameron Iron Works, assistant sergeant at arms; W. A. Davis, Baker Oil Tools Co., secretary and treasurer; H. J. Craig, Baash-Ross Tool Co., president; W. J. Nutto, Reed Roller Bit Co., vice president; O. D. Small, W-K-M Co., sergeant at arms; Gordon Richmond, Hughes Tool Co., regent and retiring president; Robert Horton, Link-Belt Co., assistant secretary and treasurer (not shown in picture)

Permian Basin, Panhandle

(Continued from page 156)

Crockett County.—Sohio Oil Co. 1 Shannon, SW SE Section 24, Block 1, GC&SF Survey, 3 miles north of Live Oak pool, showed oil in drilling from 2,100-60 ft., and was drilling ahead. The Noelke pool was extended one location southeast by Moore Bros. 2 Noelke, in Section 60, Block G, W. T. Mullins Survey, which flowed from 60-100 bbl. while cleaning out.

WEST TEXAS WILDCAT COMPLETIONS

Andrews County: Bay Pet. 1 Bitler & Lowe, 1,987 ft. from N, 660 ft. from W., Sec. 12, Blk. A-32, PSL, 1¼ mi. NE Fullerton pool, elev. 3,319 ft., flow 850 bbl. 42 gravity, pay 6,900 ft., Clear Fork lime, perf. and acid, TD 7,381 ft. Discovery East Fullerton pool.

Terrell County: Henry Schooler et al 1 Allison & Merck, SW SE Sec. 5, Blk. 2, CCSD & RGNG Sur., elev. 2,609 ft., SSO 2,340-45 ft., dry at 2,367 ft.

PANHANDLE

AMARILLO, Tex.—Canadian River Gas Co. has staked a wildcat on its block of 136,015.34 acres in Potter County. It will be the company's A-30 Bivins estate, 1,980 ft. from north and west lines of Section 192, Block B-2, AB&M Survey.

Donley County: Stanolind Oil & Gas 1 Troy Broome, 660 ft. from N & W, SE¼ Sec. 46, Blk. 20 H&GN Sur., est. 20,000 cu. ft. gas 5,015-30 ft., granite 6,748-53 ft., PB to 4,814 ft., 4,360 ft.

SOUTHEAST NEW MEXICO

HOBBS, N. M.—Operations in Southeast New Mexico were routine for the past week, with only one completion reported. Williams Oil Co. 1 Williams-State, 31-17s-33e, was a slight extension for the east part of the Maljamar field when it flowed 100 bbl. per day.

Classified Advertising

LEASES AND DRILLING BLOCK

OPEN for Oil and Gas Lease: 2,720 acres in one body; and 2,465 acres in disconnected tracts of 160 acres and more, all located in Lost Soldier District, Wyoming. Inquire of L. J. Lincecum, Rawlins, Wyo.

NEW FIELD: 2,000 acres, proven Rocky Mountain area; 87½% lease. Well required; no cash. Lessee in service. Box C-127, The Oil and Gas Journal, Tulsa, Okla.

NEW MEXICO
STATE OIL AND GAS LEASES
Humble Oil & Refining Co., now drilling a scheduled 7,500 foot test. Other major oil companies own lease blocks near test. I offer 40 acres and multiples thereof in same area. Write for information. HARRY S. WRIGHT, New Mexico State Lessee, Farmington, New Mexico.

ARKANSAS-Louisiana-Texas leases twenty acres up. Dollar acre up. Owners Box 1122, Little Rock, Arkansas.

LEASE BLOCK (720 a.) semiproven, sands 970' and 1,640' offsetting 200 bbl. discovery well, 41-G, close to production and refinery. Sell for development or trade part for well. Geologist, 912 S. Second, Lawson, Okla.

LEASES ROYALTIES

PRODUCING OR NONPRODUCING
Texas, New Mexico, Oklahoma
Louisiana and Illinois
20 Years' Experience
Inquiries Invited.

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60 Broadway Drive, Clayton
St. Louis, Mo.

LEASES AND DRILLING BLOCK

WYOMING Oil Leases on the Meridian Anticline, near shallow production. One block for drilling. R. O. Barnsley, 1133 Forest Ave., Palo Alto, Calif.

WEST TEXAS—New, long term leases, lowest price, cheapest rentals, large or small tracts. Do you have block anywhere you want drilled, OR do you want block to drill. Information and maps write: Box C-146, The Oil and Gas Journal, Tulsa, Okla.

REAL BARGAIN: New 40 acre lease, ½ mile of production. Write at once. C. A. Parker, Box 451, Center, Texas.

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PATENTS, Trade-Marks, Booklet, "General Information Concerning Inventions and Patents" and "Free Schedule" sent without obligation. Established 1915. Lancaster, Allwine & Rommel, Suite 418, Bowen Bldg., Washington, D. C.

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CAPITAL SEEKERS—Interested in raising $25,000 or more for a legitimate project should write to AMSTER LEONARD, Fox Theater Bldg., Detroit 1, Mich.

BUSINESS OPPORTUNITIES

INVENTION for sale—outright or on royalty basis, Patent No. 2200688, on self-centering metallic gasket to be placed between flange of pipe joint. Designed to reduce time, cost of installation, increase efficiency. Inquiries are requested. E. C. Bridgers, P.O. Box 112, Bishop, Tex.

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I OFFER for sale undivided 1/6th mineral interest royalty (114,614) acres) in Pecos County, Texas. This is a nonproducing royalty. C-148, The Oil and Gas Journal, Tulsa, Okla.

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Major oil company with continent-wide operations and research seeks graduate technical men of the following qualifications:

MECHANICAL ENGINEERS—with petroleum refinery or similar experience. Should be familiar with refinery design, estimating, construction, mechanical equipment, engineering materials, and utilities systems. Process knowledge desired although not essential.

CHEMISTS AND CHEMICAL ENGINEERS interested in research, design, or plant operation. Should have training and experience in refinery or other industrial organizations.

Work not of a temporary nature. In reply state experience, education, age, marital status, draft classification and salary expected, include small snapshot (not returnable). Replies strictly confidential. Applicants now employed at highest skill in war industries not solicited. Box D-670, The Oil and Gas Journal, Tulsa, Okla.

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WANTED—LIQUIDATION PROJECTS

None too large or small. Liquidate your surplus equipment now.

We buy refineries, gasoline plants, pipe lines, tanks, valves and fittings, pumps, towers and vessels.

Wire — Phone — Write

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Robt. W. Duden
Tulsa, Oklahoma

FOR SALE: 1—Gasoline Power Drilling Rig good for 3000'. 2 Jones Stagg Gas lifts complete with lines. Also Steam Drilling Rigs and pipe and casing of all sizes. We also purchase abandoned Leases, Refineries, pipe lines and other oil field equipment. If in need of material, or have material for sale, communicate with LOUISIANA IRON & SUPPLY CO., Shreveport, La., Phone 5223, or L.D. 1.

1—Parkersburg SC11 pumping unit stroke 9' to 11' in excellent condition. At a bargain price. Jos. Greenspon's Son Pipe Corp Natl. Stock Yards, Illinois.

NATIONAL Transit Vertical Triplex 4½ x 18 Oil Pump 80 HP Oil Engine. Sale cheap. Iverson Tool Company, Tulsa, Oklahoma.

FOR SALE: 72 Beaird Steel Headers, 4" I.D., 2000 lbs. test press.; 30 Brewster Steel Headers, 4" I.D., 3000 lbs. test press.; 30 B.W.Y. C.R. Headers, 4" I.D., High Pressure. ARROW PETROLEUM CO., Centralia, Illinois.

FOR SALE: At Oklahoma City, 6,500' 3" Used 10 V Thd., 9.3# U.E. S.S. Tubing Cities Service Oil, Patridge, Bartlesville, Oklahoma.

FOR SALE: 75 kw. electric A.C. generator complete $1,200; 2 Vogt 250 hp. boilers with chain grate stockers $1,250 each; pumps and cranes. Capital Ice Co., Indianapolis, Ind.

FOR SALE: Near Eureka, Kansas, 1—6' x 28' Tulsa Type 10-Tray Absorber, 75# W.P., Serial #10712. Cities Service Oil Co., Patridge, Bartlesville, Oklahoma.

FOR SALE BY OWNER
Complete Standard Drilling Rig, Slater turnbuckle derrick, 5½" rig irons, steel crown block, bull wheels and calf wheel, also 11x12 Ajax Steam Engine. Dismantled at ranch 12 miles out on Rawlins Hiway.
K. S. ALBERT, CASPER, WYOMING

SECTIONAL STEEL BUILDINGS
16'x18'x8', 16'x32'x12', 32'x52'x9'. These buildings are dismantled and are in good shape. Write, wire, or phone. O.K. Pipe & Supply Co., Phone 3-8212, Oklahoma City, Okla.

FOR SALE
Welding Rods New (Navy Rejects)
BARGAIN PRICES
PIPE
60,000 ft. 2½" Standard Black Pipe, strictly No. 1—T&C.
20,000 ft. 4" Standard Black Pipe.
7,000 ft. 8" Cast Iron Pipe, flanged.
18,000 ft. 12" 33-lb. Steel Pipe, P.E.
5,000 ft. 30" 14-guage Spiral Weld Pipe.
1,500 TONS
STRUCTURAL STEEL
Write, wire or call for prices.
SONKEN-GALAMBA CORP.
Kansas City 18, Kans.

FOR SALE: 1—84' angle iron derrick with crown block. $300.00. Melton Machinery & Supply Co., Seminole, Okla.

FOR SALE: 1 Steel Stack 55' x 4' diameter x ⅛". ARROW PETROLEUM CO., Centralia, Illinois.

FOR SALE: Pipe Line Construction Equipment—
#35 Caterpillar Diesel w/Pipe Laying Boom
#35 Caterpillar w/LaPlant Choate Blade
#12 Buckeye Ditching Machine
300 AMP Lincoln, 4 Wheel Welder
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FOR SALE: 1 Wagner Electric Motor Type B.P. Model 22 T. Three Phase 60 Cycle, 220 Volts, 850 R.P.M.'s, 25 hp. Price $300.00. Arrow Petroleum Co., Centralia, Illinois.

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D. 30 Int. Truck
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1 Float.
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Journalisms:

WHEN a wildcat drilling below 10,000 ft. blows out and catches fire, a chain of exciting events begins to happen. In next week's Engineering and Operating Section will appear a blow-by-blow description of the capping of such a well after 27 days of burning and blowing. Like most major blowouts, this particular job presented numerous problems never before encountered in wild-well operations. However, the operators, in close cooperation with supply firms, had the necessary skill and experience with which to subdue the inferno and bring the well under control. This is an exclusive story in the Journal, written by the drilling superintendent of the Union Sulphur Co., J. F. Flint, who directed the operations.

THE management of at least one refinery has been unable to reconcile the logic of pouring a flood of millions of dollars into expanding refinery facilities for the most efficient production of urgently needed products, while expending only drops to train men to operate and maintain these facilities. This refinery decided to remedy that short-sighted policy so far as its own plant was concerned, and has instituted a training program so constructed that management and labor are jointly responsible for the organization, development and operation of all phases of the plan. Details of the organization of the program will be told in an early issue of the Journal.

CALENDAR

February

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, annual meeting, Waldorf-Astoria, New York, February 20-24.

AMERICAN SOCIETY FOR TESTING MATERIALS, spring meeting and committee week, Netherland Plaza Hotel, Cincinnati, Ohio, February 28 to March 3.

March

AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS, SOCIETY OF EXPLORATION GEOPHYSICISTS, AND SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS, annual meetings, Dallas, Tex., March 21-23.

WESTERN PETROLEUM REFINERS ASSOCIATION, thirty-second annual meeting, Jefferson Hotel, St. Louis, Mo., March 28.

INTERSTATE OIL COMPACT COMMISSION, spring quarter meeting, New Orleans, La., March 31-April 1.

April

NATIONAL ASSOCIATION OF CORROSION ENGINEERS, annual meeting, Rice Hotel, Houston, Tex., April 10, 11 and 12.

NATURAL GASOLINE ASSOCIATION OF AMERICA, annual meeting, Baker Hotel, Dallas, Tex., April 12-14.

SEVENTH ANNUAL MIDWEST POWER CONFERENCE, arranged by Illinois Institute of Technology, Palmer House, Chicago, April 13-14.

NATIONAL OIL SCOUTS AND LANDMEN'S ASSOCIATION, annual meeting, Dallas, Tex., April 24-25.

May

SEVENTEENTH NATIONAL OIL AND GAS POWER CONFERENCE, sponsored by the Oil and Gas Power Division, American Society of Mechanical Engineers, Tulsa, May 8-10.